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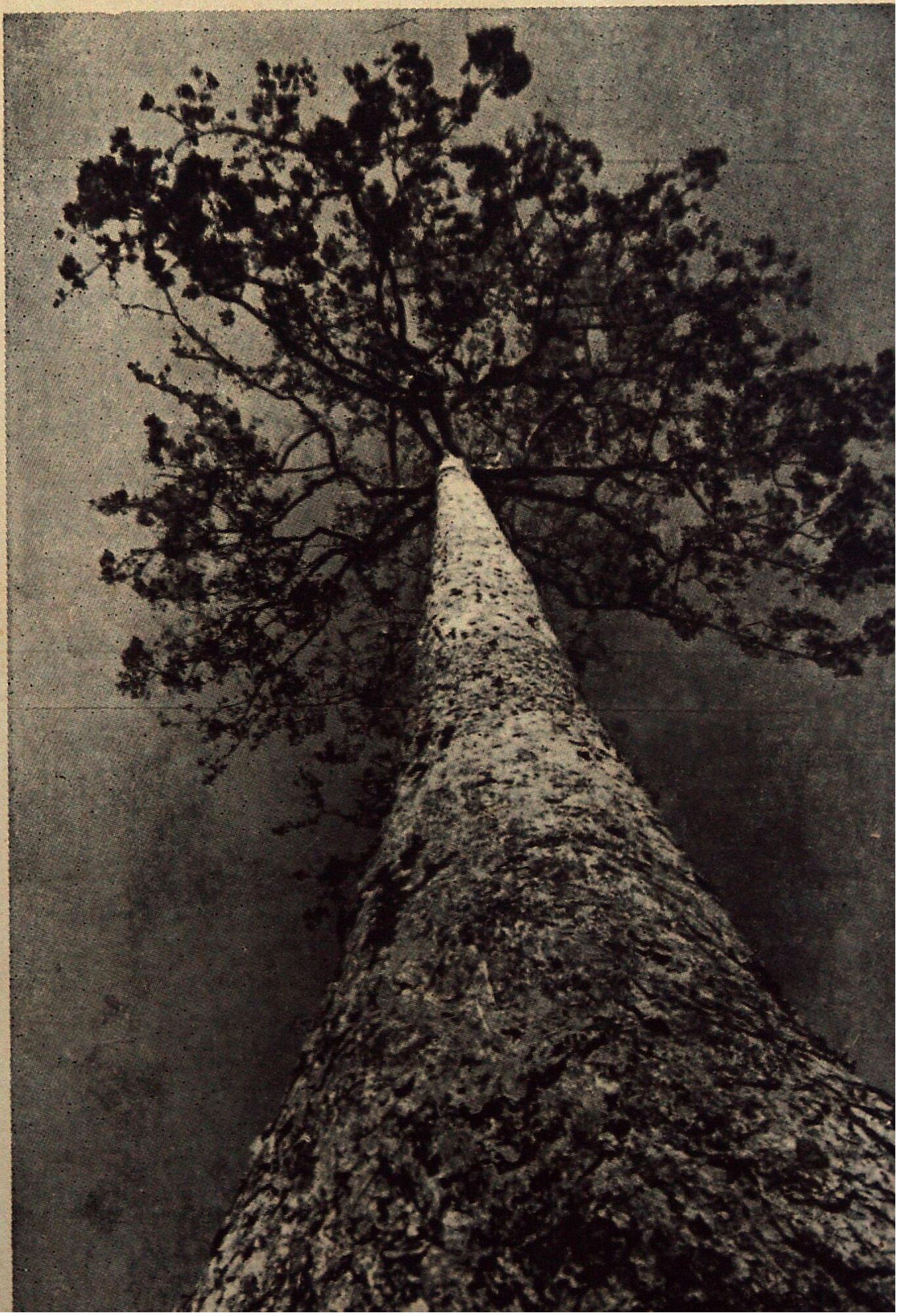

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THE INDIAN FORESTER

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EDITORIAL

Award of Brandis, Schlich, Seth and Chaturvedi Prizes

We have pleasure to announce the *Brandis*, *Schlich*, *S.K. Seth Memorial* and *Chaturvedi Prizes* for the year 1986 to the following recipients to whom we offer our hearty congratulations.

	Name of recipients	Title of Paper	Prize
		Brandis Prize	
1.	S/Shri U. Banerjee and P.K.R Choudhary.	"Preliminary studies on artificial regneration of mangrove forests in the Sundarbans, West Bengal". (Published in March, 1986 issue).	Rs. 300/-
2.	S/Shri G.P. Maithani, V.K. Bahuguna and Pyare Lal	Effect of forest fire on the ground vegetation of a moist deciduous Sal (*Shorea robusta*) forest". (Published in August, 1986 issue).	Rs. 300/-
3.	S/Shri M.C. Pande, V.N. Tandon and Mridula Negi.	"Biomass production and its distribution in an age series plantations of *Eucalyptus* hybrid and *Acacia auriculaeformis* in Bihar". (Published in November, 1986 issue).	Rs. 300/-
4.	S/Shri A.K. Singh, Arun Prasad and Balvinder Singh.	"Availability of phosphorus and potassium and its relationship with some important physico-chemical properties of some forest soils of Pali Range, Shahdol (M.P.)". (Published in December, 1986 issue).	Rs. 300/-

(*Contd...*)

	Name of recipient	Title of Paper	Prize
		Schlich Prize	
1.	S/Shri S.K. Kapur and B.N. Gupta	"Recovery of scantlings from *Eucalyptus* logs". (Published in June, 1986 issue).	Rs. 100/-
		S.K. Seth Memorial Prize	
1.	Shri S.C. Joshi	"Aerial seeding for environmental conservation". (Published in January, 1986 issue).	Rs. 300/-
2.	S/Shri G.P. Maithani, V.K. Bahuguna and J.D.S. Negi.	"Natural processes in the redeeming of Garhwal Himalayan wastelands and future strategies for reclamation—A case study". (Published in July, 1986 issue).	Rs. 300/-
		Chaturvedi Prize	
1.	Shri V.B. Sawarkar	"Animal damage : Predation on domestic livestock by large carnivores". (Published in October, 1986 issue)	Rs. 75/-

* * *

Foresters serving in the field very frequently comes upon valuable and interesting pieces of information and sometimes these observations prove very useful. Therefore, we are introducing a new column "My experience" in the next issue of the *Indian Forester* to encourage the practical field foresters by publishing their field observations in simple language related to forestry for the benefit of our readers. The write-up may not exceed 2-3 full-scape pages.

We hope that our readers will like it and also send their observations for publication in this column.

G.P. Maithani
Hony. Editor

LIFE AND LIVING STATE OF PLANTS (THERMODYNAMIC STUDY)

K.J.C. BOSE*

Introduction

What is life, is still a big unknown to the human knowledge; our understanding of the same is vague and it is still in the rudimentary stage only. The difference between the animate state and inanimate state of matter is easily recognisable. In the living state every life from exhibit certain characters like auto-poises or self-reproduction, spontaneous exchange of energy and matter with its environment as dissipative structure, registration of growth or death, and reaction to external stimuli. Some of the above characters are also exhibited by the lifeless matter at the non-equilibrium state with its environment.

The question of understanding the nature of life is attracting the attension of the human intellect since ancient times. It is often described as soul of the human beings. In scientific approach Shordinger (1942) tried to interpret life through his quantum mechanical theory. He explained that life is always associated with aperiodic matter and in this state large quantities of negatropy is generated to sustain the living state. Thus living matter develops various types of energy potentials like thermal, chemical, electrical and mechanical in the living state. At the time of registering death the living matter loses all these energy potentials and attains equilibrium state with its environment. Many other famous scientists like Gyorgii (1972) and I. Priogogine studied the life and living state. But none of them could explain how inanimate matter is able to come into animated state.

Experimental Evidence

It is a common observation that in living plants new living matter is forming as fresh growth of plant tissues through the biochemical process of photosynthesis by absorption of inanimate matter like CO_2 (Corbondioxide), H_2O (water), plant nutrients and solar energy through the media of chlorophyll (green colouring matter).

The stoicheometric chemical equation of this fundamental reaction of photosynthesis is as follows.

$$CO_2 + H\ O + Hy = (CH\ O) + O_2$$

The corbondioxide and water with addition of solar energy, chemically combine to from photosynthate and release free oxygen from water into the atmosphere. Thus the oxygen of the atmosphere is being constantly recycled through green plants. The photosynthate is finally condensing into new living cells as fresh growth in the plants enhancing the energy content of the newly formed living matter.

*Conservator of Forests, Social Forestry, Monitoring Evaluation and Publicity Circle, Hyderabad.

Photosynthesis is mainly responsible for the sustenance of practically all forms of life on this planet and the mechanism of this bio-chemical reaction is same in all the green plants right from the beginning of their evolution on earth. The author subjected this chemical reaction to thermodynamic analysis (Bose, 1971) and found that it strictly obeys the chemical thermodynamic laws as detailed below.

Applicability of Thermodynamic Laws

Thus universal bio-chemical reaction is going on in plant life all over the globe under different temperature ranges. In tropical forest ecosystem of the earth, photosynthesis is going on at 30°C or (273 + 30) = 303°K on Kelvin scale, that is mean annual day temperature; and in subtropical forest ecosystem the same reaction is going on at mean annual day temperature of 20°C or (273 + 20) = 293°K. In these ecosystems this chemical reaction is at equilibrium state or in photo stationary state with the reacting materials namely water and carbondioxide of the environment and absorbing solar energy to synthesise new living matter as biomass.

It is possible to calculate the quantity of energy consumed per unit weight of the new living biomass formed in the plants by employing the Vont-Hoff's iso-chore equation. This equation states that the logarithmic value of the ratio of the chemical equilibrium constants of photosynthetic reactions for tropical forest at T_t, (273 + 30) °K; and subtropical forests at T_s — (273 + 20) °K respectively is equal to the negative value of the products of various factors of temperatures and solar energy as stated in the equation. In mathematical terms the equation is as follows.

Vont-Hoff's Iso-Chore Equation Applictaion to Photosynthesis

$$\text{Log} \frac{K_t}{K_s} = -\frac{\Delta H}{2R} \times \frac{T_t - T_s}{T_t - T_s}$$

They can be evaluated for the photosynthesis for forest ecosystems as follows :

Expansion of the left side factors in terms of chemical equilibrium values of photosynthetic equation in the forest ecosystems of two types gives value—

$$\text{Log} \frac{(CH_2O)_t}{(CH_2O)_s}$$

$$= \log \frac{\text{Biomass prodn. in tropics/ha/ann.}}{\text{Biomass prodn. in subtropics/ha/ann.}}$$

The values of biomass productivity for tropical and subtropical forests are 35000 kg/ha/annum, and 25600 kg/ha/annum respectively as assessed by Roddin & Bazilevich (1965). The values of the terms on the right side of the equation are known except the value of ΔH. This value can be calculated by solving the equation and it works out to 4985 calories per gramme.

This value is exactly equal to the calorific value of the biomass determined experimentally and it workes out to 3.8 quanta of solar energy absorbed at 678 n.m. per mole of photosynthate (CH_2O) condensed into biomass.

As per the experimental observations for fixing one mole weight of photosynthate (CH_2O) equal to 30 gms as living plant growth, two moles of photosynthate is utilised for respiration to generate energy

needed to carry on the essential living activities of the plant. Thus plant has to produce three moles, of (CH_2O) or 90 gms of photosynthate to register growth of 30 gms (bone dry wt.) of biomass in living state.

Energy Gap in Bio-Energitic Budgetting

As per the experimental work of Emerson *et al.* (1962) in photosynthesis 8 quanta of light energy is absorbed by plants for synthesis of one mole weight of photosynthate (30 gms) at the wave length of 678 n.m containing energy 43 K. cal per quanta. Thus in all (8×3) 24 quanta of light energy is being absorbed for registering one mole of (30 gms) live plant growth. When this value is balanced with accountable sources of spending energy— that is 3.4 quanta for fixing in the plant, $3.4 \times 2 = 6.8$ quanta spent in respiration totalling to 10.2 quanta, there is unaccountable energy gap of 24—10.2 = 13.8 quanta. Each quanta has energy content of 43 K. cal. There is unaccountable energy gap equal to (24 — 10.2) = 13.8 quanta and it is equivalent to 593.4 K. cal.

The newly formed plant growth is containing 80% of water in living state. Therefore one mole equivalent of photosynthate gives rise to $30 \times 100/20 =$ 150 gms of green live biomass in the plant. The energy gap for live plant biomass works out 593.4/150 = 3.956 K. cal/gm.

Thus it can be concluded that the unaccountable energy gap in live biomass formation from inanimate matter into animate state is 3.956 K. cal or nearly 4 K. cal/gm.

Similar energy gap is noticeable in the animal kingdom also, where accurate data of bio-energitics of growth is available. For a new-born human baby of 4 kg. average birth weight, the basal metabolic energy requirement (BMR value) during first 3 months period, is found to be 52.5 to 55.7 K. cal per day per kg of live weight (Penmore, 1976). The initial average growth rate of the new baby is 200 gms per week during first two to four weeks period (Sheila M. Bantes, 1979).

As the baby grows up to maturity of 60 kg weight at 20 years, when further growth practically ceases; the B.M.R. value is only 27.4 K. cal per day per kg live weight of the individual. That means for all the physiological activities of human organism, at peak efficiency of youthful stage, when new growth has stopped, the energy need is only 27.4 K. cal/kg live weight per day. Therefore the high energy need at infancy is required for putting on new growth that is addition of new living matter to the individual. This will enable to calculate the energy gap per unit weight of newly formed living matter :

The B.M.R. of new-born infant

= 52.3 to 55.7 K. cal/kg live wt.

The B.M.R. value of grown up individual.

= 27.4 K. cal/kg live wt.

The surplus energy available

= 24.9 to 28.3K. cal/kg live wt.

Surplus energy available for infant of 4 kg body weight in 7 days or (one week)

= $24.9 \times 4 \times 7$ to $28.3 \times 4 \times 7$ K. cal

The average growth registered by new infant

= 200 gms. per week.

The surplus energy for new growth over and above physiological need of the baby :

3.48 to 3.9 K. cal/kg. live wt.

$$\frac{24.9 \times 4 \times 7}{200} = 3.481 \text{ to}$$

$$\frac{28.3 \times 4 \times 7}{200} = 3.962$$

Thus the unaccounted energy gap in case of human growth works out to 3.481 to 3.962 K. cal per gm live weight when compared with 3.956 K. cal per gm of plant growth.

The chemical energy available in the living system may be getting associated with the evolved matter for the conversion from inanimate state to animate state at the rates worked out above in plant kingdom as well as in animal kingdom.

Explanation of Life and Living State

The inanimate matter in the plant kingdom is utilising nearly 4.86 K. cal/gms of chemical energy for condensing into bio-mass from the basic components of CO_2 and H_2O. This energy is recoverable as calorific value when the plant biomass is burnt back into CO_2 and H_2O. Hence this energy is getting fixed up at the electronic orbital level of the chemical bonds of molecules of the biomass for the chemical combination. The extra energy associated with this biomass to transform it from inanimate state to animate state can also exist in this some electronic structures of the molecules making the electrons of the outer shells in the orbits more labile or energized to enable the live matter to discharge the functions of the living state. The same applies to the living state of matter in the animal kingdom also. This energy is not sufficient for the quantum leap of electrons to outer orbits but enough to keep them in activated state so that the matter is more chemically active, with electrical conductivity.

The above findings enables to give rational explanation for various properties exhibited by matter in the living state when compared to the same matter in the non living state or dead matter. Various electrical properties exhibited by living organism - like conduction of electricity or building up electrical energy gradients are attributed to the labile and free electrons present in the living state due to the association of extra energy. Living matter in plant or animals, inspite of its separation by dissection from its parent organism, continues to be in the activated state of living and hence, when grafted back to its own parental body or to any organism for substitution it combines and continues to function. Therefore for organ transplantation in surgery or for grafting in plants only fresh material in the activated state of living is required for successful grafting. The dead material of the same which is not in the active state will not fit in this grafting process.

In the living plant the chlorophyll structures are in such activated state due to the addition of extra quantity of life energy into their electronic structure, with the presence of labile or free electrons in their orbitals. When light photons strike the live chlorophyll structures (chloroplasts) they are able to throw out photo electrons which split water molecules and

start chain reaction of photosynthesis. Where as in the dead state the chlorophyll structures, can not generate such photo electrons to start photo-synthesis. Therefore the inability *'in-vivo'* is explainable scientifically. If the chlorophyll structures *'in-vitro'* are infused with extra does of energy through some means to bring them into the so called live state the photosynthesis can be carried out successfully and continuously.

The living state of matter in plants or animals is the peculiar phenomena of higher energy state of matter and requires continuous supply of energy as maintenance doses to keep in higher energy state for discharging biological functions. It should be detectable through some experimental methods of instrumental analysis like absorption spectra-scopy or some such means for experimental varification.

The flourescence spectrum of pure chlorophyll 'a' in eather compared with that of a sample of chlorophyll *'in vivo'* sea lettuce (Ulva sp.) shows absorption at 662 mμ and 678 mμ respectively indicating that chlorophyll *in-vivo* is in different state of energy (Stacy French 1962). The matter in the living state is at higher energy level when compared with its counter part. To maintain it in this state continuous supply of energy as maintenance doses as food is needed. Thus it can be inferred that life is a manifestation of energy and it is different from known forms of energy.

Thus a clue may be found for the origin of life on earth surface. In the primordial reducing environment of earth Miller & Stantly (1962) found that the matter can evolve spontaneously into building blocks of life as polynucleotides. Further according to Barnal (1981) the abiotic metabolic process was also in existance for generation of chemical energy. Some catalytic material which could absorb this chemical energy and transmit to the evolved aperiodic matter of polypeptides to condense into co-acervates, such energised particles could evolve further into first primitive living particles of life. The catalytic agent may be nothing but clay particles which were weathered from earth surface of that time (late Cambrian age or earliest carboniferous age of geological time washed down into puddles of rain water). These clay particles even today exhibit peculiar properties for absorption of chemical energy. If this type of catalytic material could be identified now it should be possible to synthesise living particles afresh.

SUMMARY

Thermodynamic study of living state in plants indicate accurate applicability of chemical thermodynamic laws to plant growth, since it enables to calculate theoretically the calorific value of biomass of the plants. Accountability of the input energy and its utilization in the living plant, indicates energy gap of 3.9 K. cal per kg of living plant system. Similar energy gap is also noticeable when the energy production and utilization as B.M.R. is examined in new born human baby and the energy gap works out to 3.48 to 3.9 K. cal per kg of live weight in case of human beings. This energy is responsible to convert the matter from inanimate state to animate state and the matter in living state is at higher energy state. The

experimental findings of the absorption spectra of chlorophyll *in-vivo* has an absorption band of at 678 milli microns where as the extracted chlorophyll *in-vitro* has absorption band at 662 milli microns indicating energy difference in the living state. This leads to the postulation that life is a manifestation of energy and it is different from the known forms of energy. This gives scientific explanation for origin of life on earth.

पादपों का जीवन और जीवित अवस्था । ऊष्मागतिकीय अध्ययन ।

के०जे०सी० बोस

सारांश

पादपों की जीवित अवस्था का ऊष्मागतिकीय अध्ययन रासायनिक ऊष्मागतिकी के नियमों को पादप वृद्धि के सही-सही उपयोग में लाने का दिशा संकेत देता है क्योंकि इससे पादपों के जैवपुंज की औष्मिक अर्जा का आगणन सिद्धान्त रूप में किया जा सकता है। उपयोग में किए गए ऊर्जा साधनों का लेखा-जोखा लगाने और जीवित पादपों में उनका उपयोग करने से संकेत मिला है कि जीवित पादप की संहति में प्रति किग्रा० 3 9 किकैल० का अन्तर रहता है। ऊर्जा उत्पादन और उसे उपयोग में इसी तरह का अन्तर नवजात मानव शिशु का बी०एम० रेकार्डर द्वारा परीक्षण करने पर पाया जाता है जो मानवों में सजीव भार के प्रति किग्रा० में 3,48 से 3.9 किकैल० तक होता है। यही ऊर्जा अजीव अवस्था को सजीव अवस्था में बदलने के लिए उत्तरदायी है, और इसी से सजीव अवस्था में पदार्थ अधिक ऊर्जायुक्त अवस्था में रहता है। जीवों में पर्णहरिम का प्रचूषण वर्णपट इस संपरीक्षण द्वारा 678 मिली माइक्रोन प्रचूषण वर्णपट वाला निकला जबकि काचीय अवस्था में निस्सारित पर्णहरिम का प्रचूषण वर्णपट 66 मिली माइक्रोन रहा जिससे यह संकेत मिलता है कि सजीव अवस्था में ऊर्जा अन्तर रहता है। इससे हम इस निष्कर्ष पर पहुँचते हैं कि जीवन ऊर्जा का ही परिवर्तित रूप है तथा यह ऊर्जा के ज्ञात रूपों से भिन्न होता है। इससे हमे इस धरा पर जीवन के उद्भव का वैज्ञानिक स्पष्टीकरण प्राप्त होता है।

References

Barnal, J.D. (1981). Personal communication from K. Bahadur. Prof. Allahabad University.

Bose, K.J.C. (1971). Thermodynamic study of plant growth in Nature *Indian For.*, **97** (7) : 363-367.

Emerson *et al.* (1962). This is life. Holt Rinehart and Winston Publication. Page 12.

Gyorgii, A.S. (1972). The living state.

Miller Stantly, L. (1962). The Origins of like—This is life 317-343, Holt Rinehart and Winston—New York.

Penmore, P. (1976). A comparison to Medical studies. Vol. I, pp. 4.7 to 4.9 Blackwell Scientific Publication.

Roddin, L.E. and N L. Bazilevich (1968). Productivity of World Forests in N. Hemisphere Doklady Akademic NAUSE, S.S.S.R. 157 (1) p-215-3.

Sheila M. Bantes (1979). Practical Pedriatic Nursery IInd ed. page No. 70; Blackwell Scientific Publication, Oxford.

Shordinger, E. (1942). What is life; Macmillan Press London.

Stacy French, C. (1962). Photosynthesis. This is life. pp. 20-21.

PRELIMINARY STUDIES ON SEED GERMINATION BEHAVIOUR OF *BERBERIS LYCIUM*, ROYLE—AN IMPORTANT SHRUB FOR RECLAMATION OF WASTELANDS IN THE HIMALAYA

V.K. BAHUGUNA, M.M.S. RAWAT AND S R. JOSHI

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Introduction

The genus *Berberis* Linn (fam. Berberidaceae) consists of spiny shrubs widely distributed in temperate and sub-tropical regions of the northern hemisphere and temperate South America (Brandis, 1906). Kanjilal (1928) mentioned occurence of 8 species in Chakrata, Dehra Dun and Saharanpur Forest Divisions. Maithani *et al.* (1986) reported that the species of *Berberis* are extremely suitable for regreening the barren and degraded lands as they are well adapted to hard rocky and pebbly soils.

All species of *Berberis* are gregarious in habit. Flowers are yellow and fruits are ovoid berries, red or deep purple when mature. Most of them have a pleasent edible fruits. The extract (Rasaut) from wood and bark of almost all the species is a tonic and febrifuge. A yellow dye obtained from wood and root is used in colouring and tanning leather and is perhaps one of the best tanning dyes in India (Jamble, 1902). Some species are ornamental on account of their foliage and flowers.

B. lycium is among the most important species of Himalaya in having umbellatine as a major alkaloid. Rasaut was once considered to be a special preparation from this species.

Though the species is gaining importance in reclamation of degraded areas due to its variety of uses and adaptability to hard rocky soils; there is however, no available record on its propagation techniques. A preliminary investigation was, therefore, carried out in order to determine seed morphology and germination behaviour in laboratory and nursery. The study will be of immense importance in artificial propagation of this species through seeds.

Material and Methods

Fresh matured fruits were collected during last week of June, 1987 from Chakrata and depulped within 3 days by rubbing on wirenet and hardware cloth. Extracted seeds were surface dried in sun for one day.

Seed morphology was observed with the help of a hand lens and initial viability was determined by cutting test. Seeds were soaked in water for 24 hrs and soundness of the embryos was observed. Germination tests were conducted in laboratory as well as in nursery. In laboratory, seeds were sown on top of paper and in sand filled in enamelled trays kept in a walk-in-

germination room maintained at 30°C. In nursery, seeds were germinated in earthen pots filled with soil, sand and FYM in the ratio of 2 : 1 : 1. Four replicates of 100 seeds each were taken for each treatment and germination was recorded daily till 30 days.

Result and Discussion

Average size of the fruit was found to be 0.9×0.5 cm and 1-3 seeds were observed in each fruit. Seeds are brown, 0.4×0.2 cm in size, somewhat triangular and about 1,59,000 weigh one kilogram. Seed coat is thin, somewhat tough but permeable to water. Embryo is 0.3 cm long with two leafy cotyledons enclosed in stiff endosperm.

The lot exhibited only 82% viable seeds by cutting test. Rest of the seeds were non-viable with degenerating embryos and endosperm. Though, the seeds germinated without any pre-sowing treatment, it seems that they are slightly dormant as out of 82% viable seeds only 56%, 33% and 34% germination was obtained respectively in soil, sand and top of paper (Table 1).

The seeds gave maximum germination percentage in soil under nursery conditions (22.9°C - 33.7°C) as compared to sand and top of paper under controlled temperature (30°C). Speed of germination was also rapid in soil as compared to other media of sowing.

Within a month of sowing about 50% of the seedlings died in earthen pots due to damping off. Rest of the seedlings were transplanted in polythene bags.

Table 1

Germination capacity of B. lycium seeds as influenced by various sowing media.

Sowing media	Emergence (days)	Completion of germination (days)	Germination (%)
Soil (Soil : Sand : FYM) 2 : 1 : 1	9	15	56
Sand	10	21	33
Top of paper	9	18	34

SUMMARY

This paper presents the results of experiments carried out in order to determine seed morphology and germination behaviour of *Berberis lycium* Royle.

हिमालय क्षेत्र की बंजर भूमियों के पुनरसंस्कार के लिए महत्वपूर्ण क्षुप बर्बेरिस लीसियम रायले के बीजों के अकुरण व्यवहार का प्रारम्भिक अध्ययन

बी०के० बहुगुणा, एम०एम०एस० रावत व एस०आर० जोशी

सारांश

इस अभिपत्र में बर्बेरिस लीसियम रायले के बीजों की रचनाकारिकी और उनके अंकुरण व्यवहार को विनिश्चित करने के लिए किए गए सपरीक्षणों के परिणाम प्रस्तुत किए गए हैं।

References

Brandis, D. (1906). Indian Trees. Archibold Constable & Co. Ltd., London, p. 28.

Jamble, J.S. (1902). A manual of Indian Timbers. Sampson Low Marston and Company Ltd., London. pp. 28-30.

Kanjilal, U.N. (1928). Forest flora of the Chakrata, Dehra Dun and Saharanpur Forest Divisions, United provinces II edition, Central Publication Branch, Calcutta. pp. 45-49.

Maithani, G.P., V.K. Bahuguna and J.D.S. Negi (1986). Natural processes in the redeeming of Garhwal for reclamation—A case study. *Indian For.*, **112** (7) : 608-615.

BIOMASS ESTIMATION AND DISTRIBUTION OF NUTRIENTS IN FIVE DIFFERENT AGED *EUCALYPTUS GRANDIS* PLANTATION ECOSYSTEMS IN KERALA STATE

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Introduction

All over the country, increasing attention is now being paid for large scale afforestation programmes to meet the severe crisis arising out of shortage of timber, fuelwood and raw material for wood based industries. A number of multi-purpose fast growing exotic species are therefore, being raised by Forest Department, Forest Corporations etc. in various parts of the country. Among the large number of exotics tried so far, *Eucalyptus* has proved to be most versatile genus, due to its fast growing habit, high adaptability to various types of edaphic and climatic conditions and high pulp yield. Farmers prefer *Eucalyptus* species in their farm forestry programmes for its various advantages. The two Eucalypts which have performed well in Kerala are *Eucalyptus grandis* and *Eucalyptus tereticornis*. Out of these *Eucalyptus grandis* is found growing well in the higher ranges of Kerala (Basha, 1984). In considering this view authors have, therefore taken interest in the biomass estimation of *Eucalyptus grandis* plantations raised in Kerala State. While estimating the biomass production of short rotation woodlands, the nutrients immobilized in the crop, the nutrients removed permanently from the site by exploitation are of much concern and can not be ignored. To enable estimate, it is necessary to ascertain the total amount of nutrients immobilized in the crop and their distribution between various tree organs.

Thus, the aim of the present study is to obtain information on organic matter production, its distribution between various tree components, the distribution of nutrients among component plant parts and the effect of whole tree harvesting of these ecosystems on the site at different ages.

Study Area

The studies were undertaken in Wynad Wildlife Century Division in Kerala State. Originally this area was covered with scattered mixed tree species, having irregular canopy and the tree growth was very poor. The entire area was finally clearfelled and *Eucalyptus* plantations were raised. The study site is situated in the zone of southern moist deciduous forests (Champion & Seth, 1968) at an altitude 785 m and receives an average annual rainfall of 1303 mm. The onset of south-west monsoon brings the greater part of the rain. Average minimum and maximum temperature varies between 10°C to 33°C. The soil is loamy with varying degree of clay and traces of mica.

Five stands of 3, 5, 7, 9 and 11 years of age, were selected for the present study and the details of these stands are set out in Table 1.

Methodology

Field studies were conducted in 1986, using stratified mean tree technique (Art & Mark, 1971). One representative study plot was laid out in each plantation. All the standing trees within the plot were grouped into three diameter classes. One mean tree from each diameter class was harvested and the fresh weight of each of the component was recorded immediately after felling. One root system (sample tree close to the mean diameter of the crop) was dug out and fresh weight recorded for underground biomass estimation. Representative samples from each component plant parts including root were collected for dry weight and nutrient estimation.

Correlation Coefficient and Regression models were worked out between independent variables (d.b.h and height) and dependent variables (Bole, Bark, Leaf, Twig, Branch and Root), to enable to predict the biomass on a regional basis. This would obviate to a great extent the necessity of destructive sampling.

Results and Discussions

Organic matter in sample trees : Component-wise oven dry weights of sample trees are given in Table 2. Though these are even aged plantations raised under similar climatic and edaphic conditions, with no other associate, the trees differ greatly in size and weight. The dry weight increases with increasing diameter and maximum is produced in C class trees, having highest diameter in each plantation. Age effect is also clearly seen and the maximum above-ground and total biomass (952 kg and 1040 kg respectively) is produced by C category tree at the age of 11 years. Singh & Sharma (1976) estimated 53.18 kg/tree at the age of 5 years increased to 197.50 kg/tree at 9 years age (average of the three diameter classes) in their study on *Eucalyptus tereticornis*. The percentage contribution of bole biomass to above-ground biomass increases with increasing diameter and age and varies between 28% and 86%. The

Table 1

Details of five different aged plantations of Eucalyptus grandis

Age (yrs)	Total area (ha)	Density/ha	Mean diameter of the crop (cm)	Mean height of the crop (m)	Variation in three diameter class (cm)		
					A	B	C
3	31	1700	8.6	13.85	1- 5	6-10	11-15
5	240	1650	12.3	18.40	3- 8	2-14	15-20
7	106	1100	14.0	25.90	4-11	12-19	20-27
9	197	1020	17.5	28.20	7-14	15-22	23-30
11	100	689	23.7	34.00	12 20	21-29	30-38

Table 2

Dry weight (kg/tree) of component plant parts of sample trees of three diameter classes of different aged plantation of Eucalyptus grandis.

Age	Diameter class	Bole	Bark	Leaf	Twig	Branch	Total above-ground	Root	Total biomass
	A	1.06	0.29	0.87	0.65	0.97	3.84	*0.58	4.42
3	B	14.67	2.16	1.30	1.70	3.25	23.08	3.47	26.55
	C	47.45	5.53	2.32	3.70	6.72	65.72	*9.87	75.59
	A	6.94	0.99	0.92	1.68	3.31	13.84	*2.12	15.96
5	B	31.79	3.47	2.16	2.96	3.60	43.98	2.72	50.70
	C	86.94	12.08	4.84	3.03	5.28	112.17	*17.14	129.31
	A	12.94	1.85	1.52	1.22	3.08	20.61	*2.88	23.49
7	B	66.79	6.62	2.01	2.21	2.50	80.13	11.18	91.31
	C	225.53	22.29	9.10	8.00	14.31	279.23	*38.96	318.19
	A	33.42	4.41	1.68	1.92	4.16	45.59	*5.75	51.34
9	B	147.61	17.30	6.00	4.80	5.18	180.89	22.80	203.69
	C	335.81	36.49	5.28	8.61	7.63	393.82	*49.64	443.46
	A	84.47	8.62	3.89	3.95	7.00	107.93	*10.01	117.94
11	B	348.81	34.09	7.80	8.64	14.64	413.98	38.40	452.38
	C	820.13	63.81	17.16	14.76	35.96	951.82	*88.29	1040.11

* Figures marked with asterisks are the calculated values as roots were not sampled in these trees.

percentage contribution of leaf, twig and branches decreases with increasing age and diameter. No definite trend was observed in case of bark. Considering B category trees (root actually dug out) only, the percentage root biomass to above-ground biomass also decreases from 15% to 9% with increasing diameter and age. These results are in agreement with those reported earlier for *Eucalyptus tereticornis* (Singh & Sharma, 1976), *Eucalyptus* hybrid (George, 1977) and *Eucalyptus globulus* (Negi *et al.*, 1984).

Biomass prediction : The basic data of all the sample trees processed at Forest Computer Centre, Forest Research Institute Dehra Dun, to obtain a set of regression equations for prediction of biomass on a regional basis. The biomass of each component was considered separately and following regression models were tried.

$$Y = a + bx \quad \text{......(A)}$$

$$\text{Log } Y = a + b \log x \quad \text{......(B)}$$

Where Y is biomass, x is D^2H in case of (A) and D.B.H. in case of (B) and a and b are usual regression coefficients.

The regression equations along with

correlation coefficients for simple linear case (A) and allometric relationship (B) are given in Table 3 and 4 respectively.

To have an idea of combined effect of D.B.H. and Height (being most effective parameter to determine biomass) following multiple regression model was also tried.

$$Y = a + bx_1 - cx_2$$

Where Y is biomass, x_1 is D.B.H., x_2 is height and a, b, c are the usual regression coefficients.

The regression equations developed from this equation are presented in Table 5.

In case of simple linear regression, D^2H was found to be highly correlated with other character. The allometric relationships developed, using D.B.H. as the predictor variable and when compared with the earlier model gave better values of r^2, except for the variables leaf, twig and branches. Multiple regression equations attempted later. did not improve the predictions. Moreover using height as an additional variable should not be preferred from the cost point of view, when equally efficient prediction models are available with D B.H. alone, D.B.H. being highly correlated to height (Table 4) and is the easiest measurable parameter.

The actual figures of dry weight of various tree components were plotted separately on double log graph paper against d.b.h. and allometric relationship fitted (Figs. 1 to 8). Highly significant correlation coefficients confirm the positive and linear trend, suggesting that d.b.h. can be used as the most reliable parameter for estimation of total standing biomass, total standing above-ground biomass and component plant parts. The same independent variable has been used by George (1977) in *Eucalyptus* hybrid plantation and Hingston *et al.* (1981) in *Eucalyptus marginata* plantations, Singh & Sharma (1976) in their study on *Eucalyptus tereticornis* observed D^2H and d.b.h. as the best fitted independent variables for estimation of biomass, Rai (1984) worked out regression models for individual species in a tropical rain forest and found D^2H as to be the best estimator of above ground-biomass. Kushalappa (1984) prepared a biomass weight table for Eucalypts using multiple regression models. Schonau and Bonden (1981) while working on young *Eucalypts* have tried various model and found square of breast height diameter as the best fitted independent variable. Cromer *et al.* (1975) used only basal area as predictor variable.

Total biomass : The total standing biomass (kg/ha) has been calculated with the help of the density of the trees of each diameter class at different ages and is presented in Table 6. The above-ground biomass increases nearly five times from 3 (56332 kg/ha) to 11 (275050 kg/ha) years of age. The above ground biomass produced at the age of 7 years is slightly less than that produced at the age of 5 years. Though the bole biomass increased more than 5000 kg from 5 years to 7 years of age. The biomass propuced by other components was much less. This may possibly be due to biotic interference, moreover the biomass is greatly influenced by stocking density, seven years old stand is comparatively under stocked (Table 1). Similar results have also been reported earlier, George, 1977; Negi

Table 3

Linear regression equations and coefficients of correlation for the variable D^2H with other characters

Variables (Y)	Equations	Correlation coefficient (r)	Level of significance
Bole weight	$Y = -11.9421 + 0.0163\ D^2H$	0.998	***
Bark weight	$Y = 1.3817 + 0.0013\ D^2H$	0.990	***
Leaf weight	$Y = 1.3466 + 0.0003\ D^2H$	0.952	***
Twig weight	$Y = 1.6894 + 0.0003\ D^2H$	0.973	***
Branch weight	$Y = 1.6459 + 0.0006\ D^2H$	0.946	***
Total above ground biomass	$Y = -5.8784 + 0.0189\ D^2H$	0.998	***
Root biomass	$Y = 2.5894 + 0.0018\ D^2H$	0.989	***
Total biomass	$Y = -3.2911 + 0.0207\ D^2H$	0.999	***

Where D is diameter and H is height

*** Indicate significance at 0.01% level of probability.

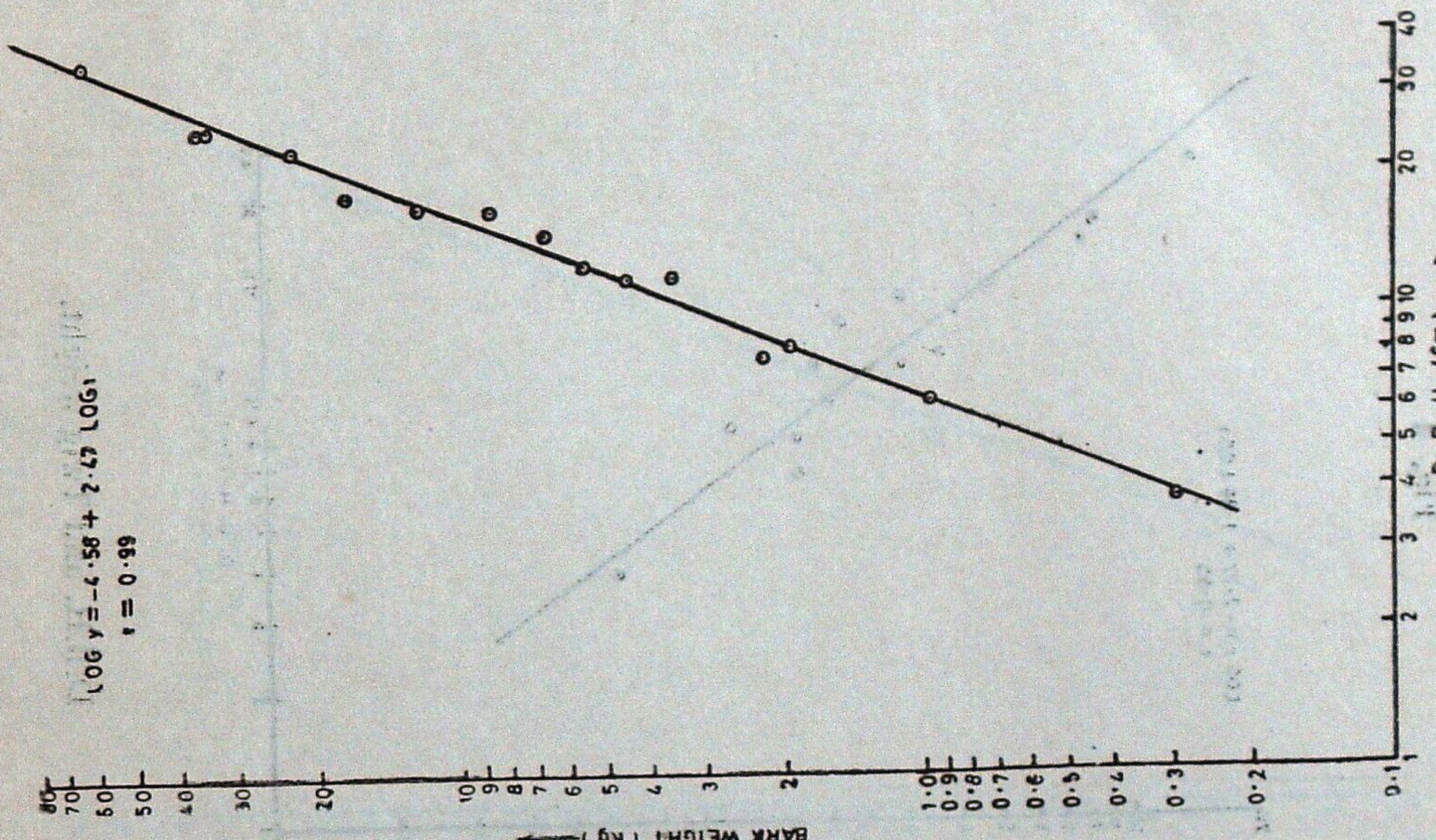
Table 4

Log linear regression equation and coefficients of correlation of d.b.h. with other characters.

Variables (Y)	Variables (X)	Equations	Correlation coefficient (r)	Level of significance
Height	D.B.H.	$\text{Log } Y = 1.10 + 0.75 \text{ Log } X$	0.99	***
Bole weight	D.B.H.	$\text{Log } Y = -3.59 + 2.90 \text{ Log } X$	0.99	***
Bark weight	D.B.H.	$\text{Log } Y = -4.58 + 2.47 \text{ Log } X$	0.99	***
Leaf weight	D.B.H.	$\text{Log } Y = -2.56 + 1.41 \text{ Log } X$	0.94	***
Twig weight	D.B.H.	$\text{Log } Y = -2.37 + 1.36 \text{ Log } X$	0.95	***
Branch weight	D.B.H.	$\text{Log } Y = -1.67 + 1.28 \text{ Log } X$	0.88	***
Total above-ground biomass	D.B.H.	$\text{Log } Y = -2.08 + 2.46 \text{ Log } X$	0.99	***
Root weight	D.B.H.	$\text{Log } Y = -3.58 + 2.26 \text{ Log } X$	0.99	***
Total biomass	D.B.H.	$\text{Log } Y = -1.90 + 2.44 \text{ Log } X$	0.99	***

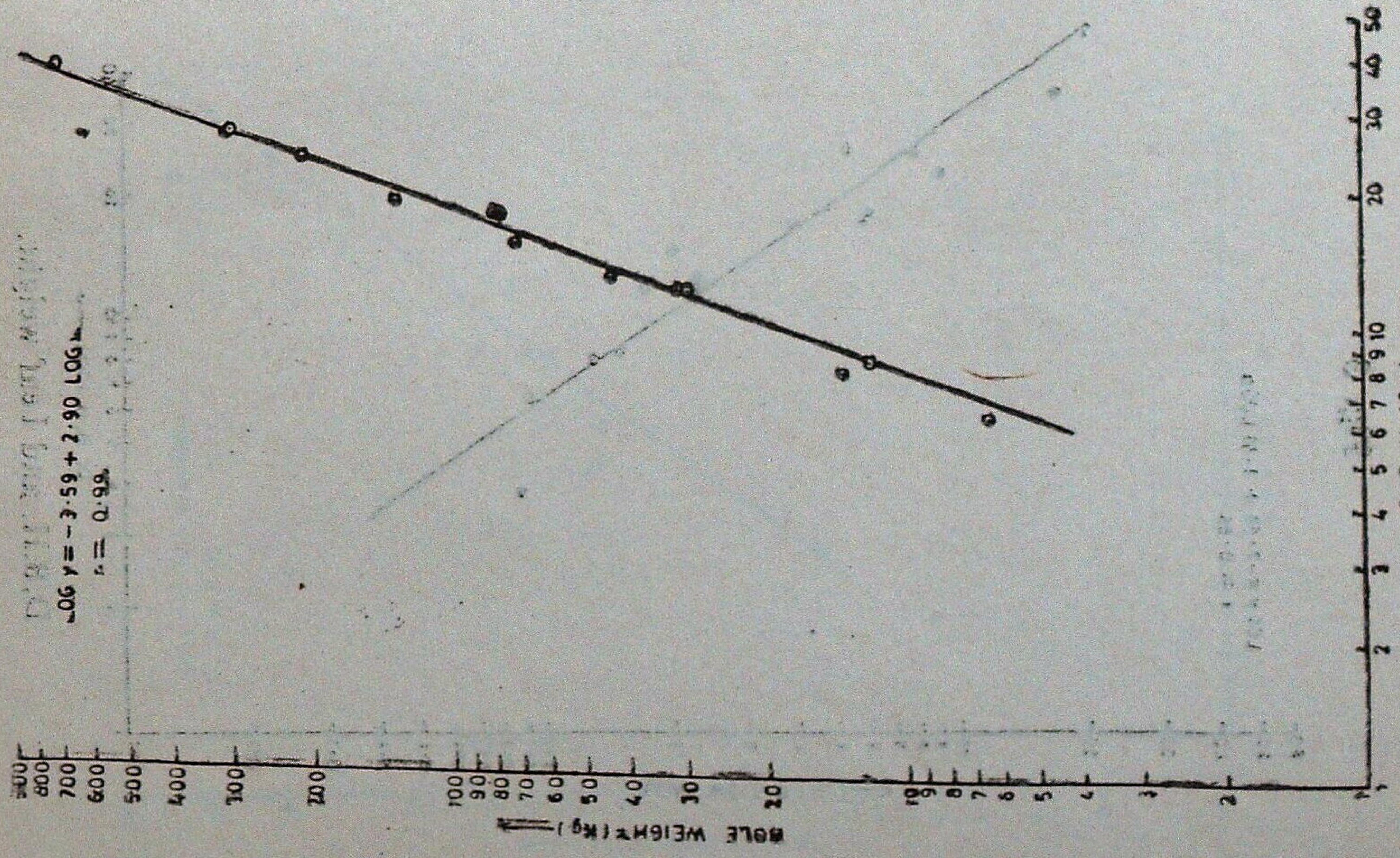
*** Indicate significance at 0.01% level of probability.

Fig. 2



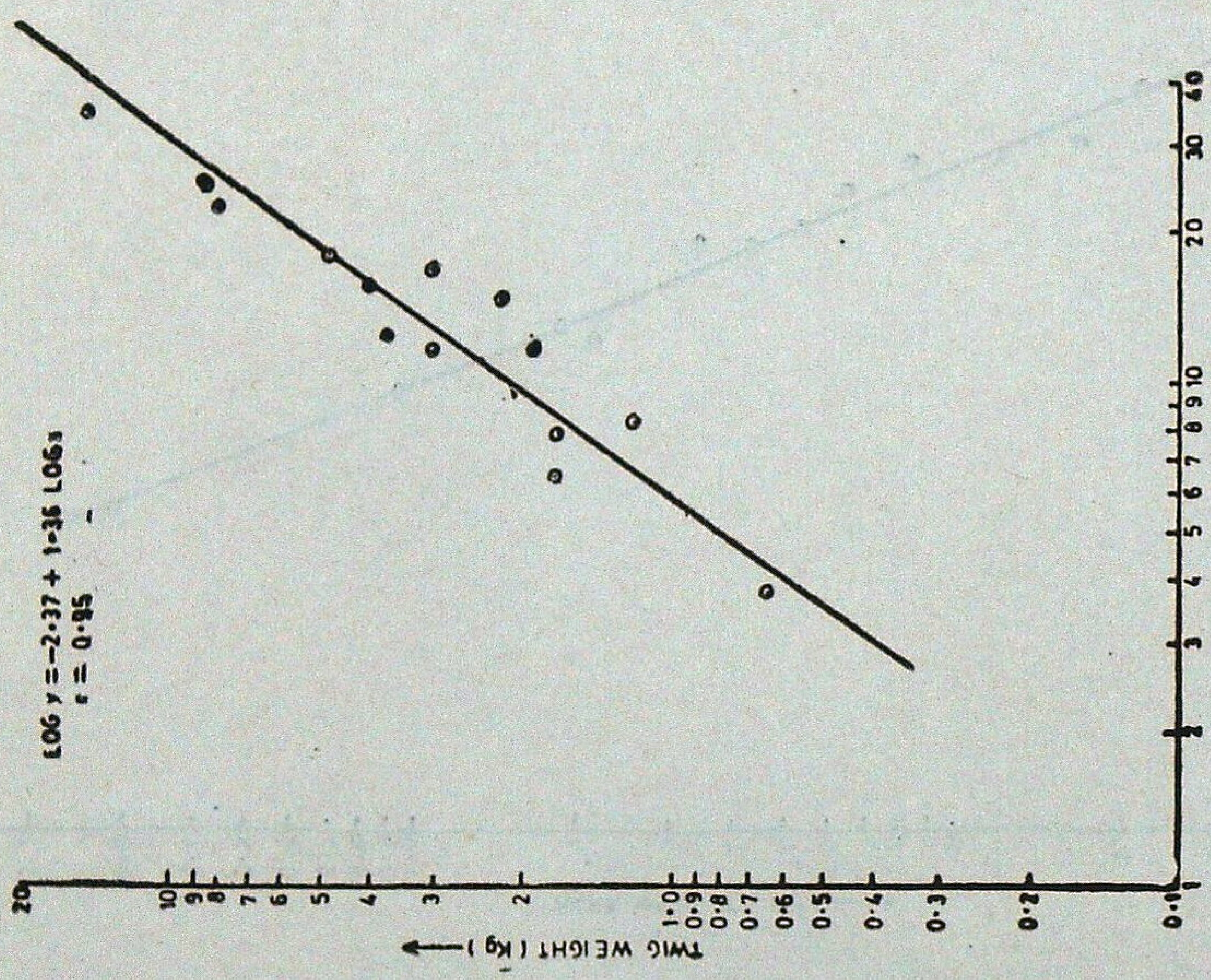
D.B.H. and Bark weight.

Fig. 1



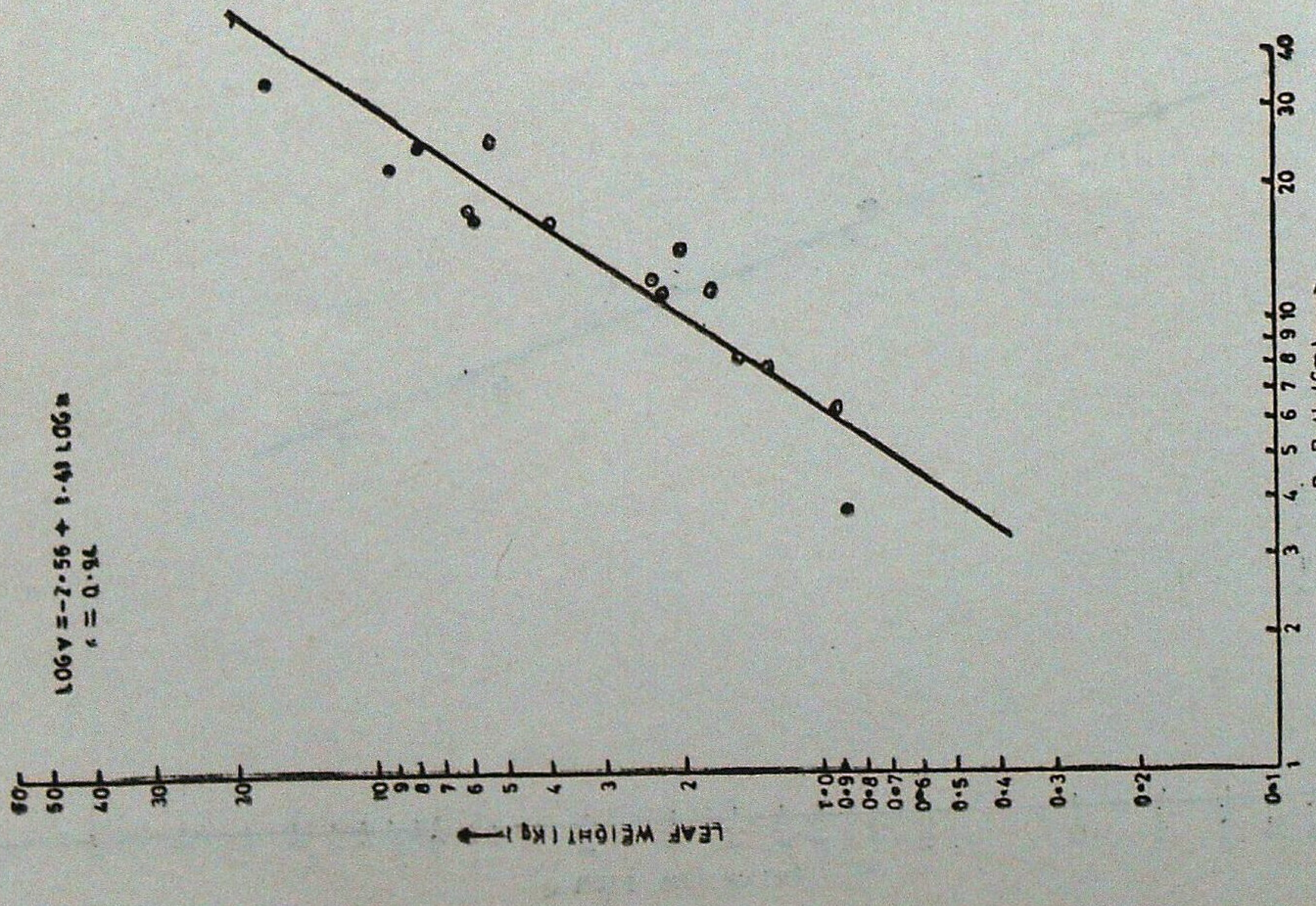
D.B.H. and Bole weight.

Fig. 4



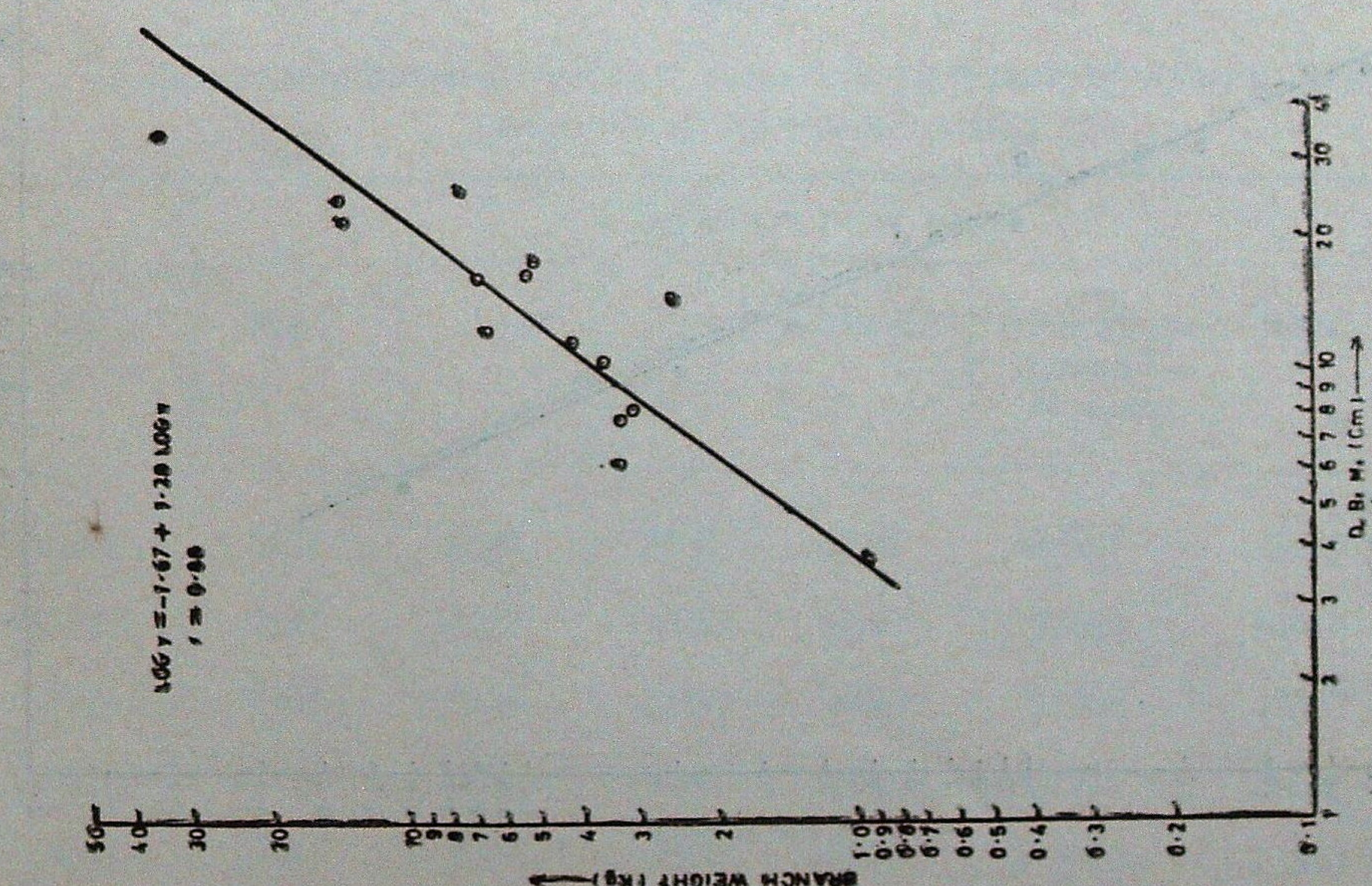
D.B.H. and Twig weight.

Fig. 3



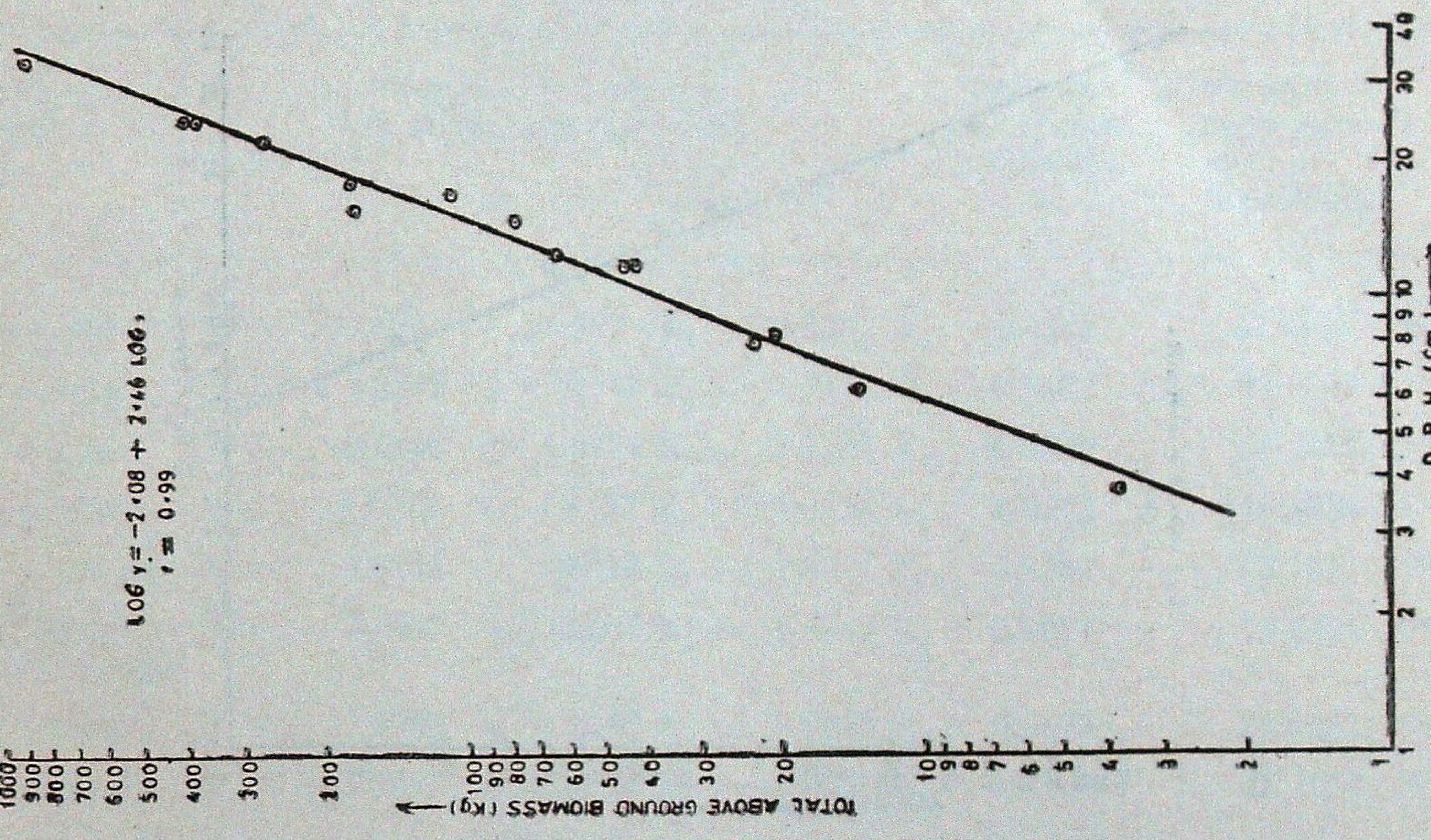
D.B.H. and Leaf weight.

Fig. 5



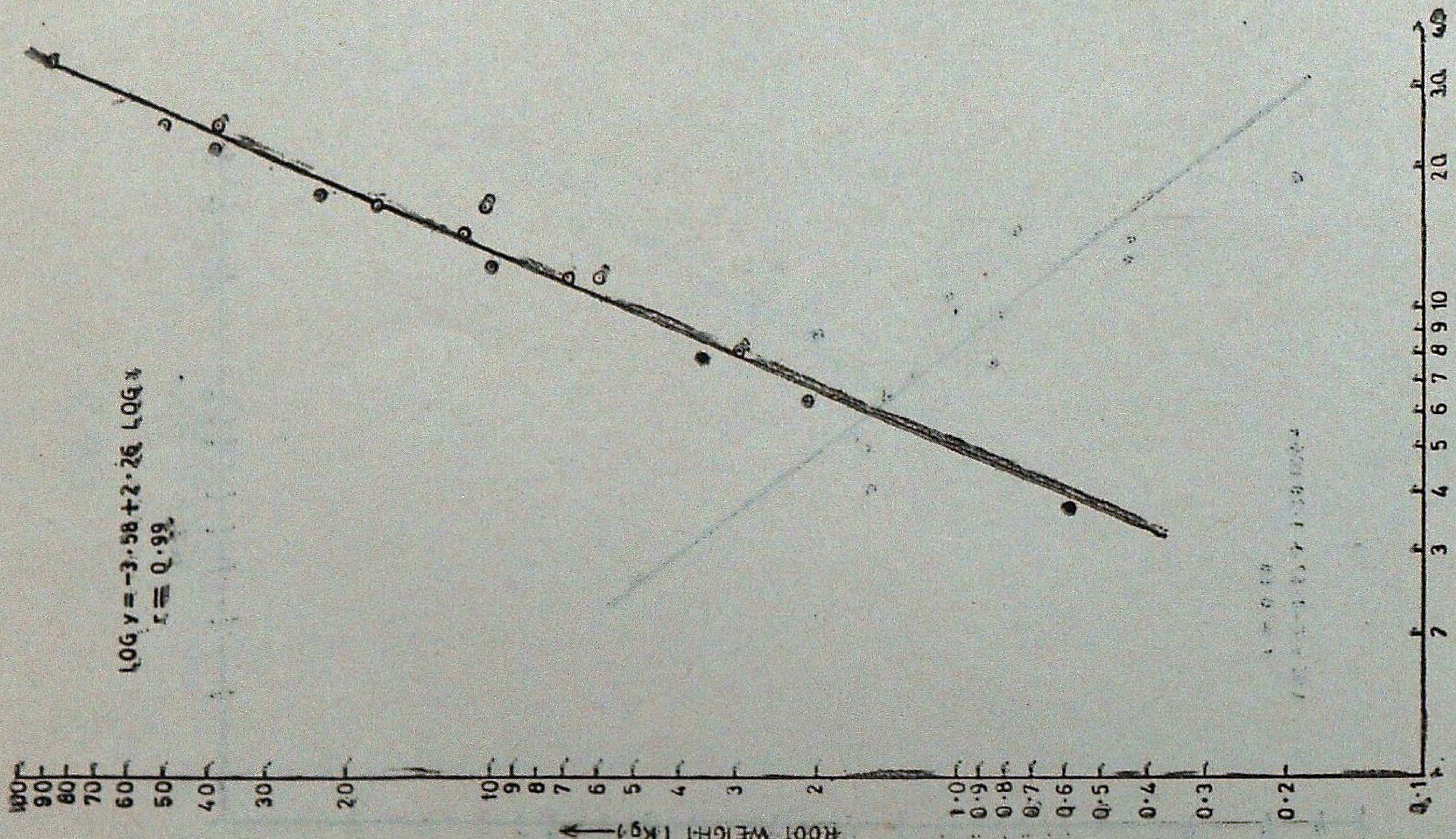
D.B.H. and Branch weight.

Fig. 6



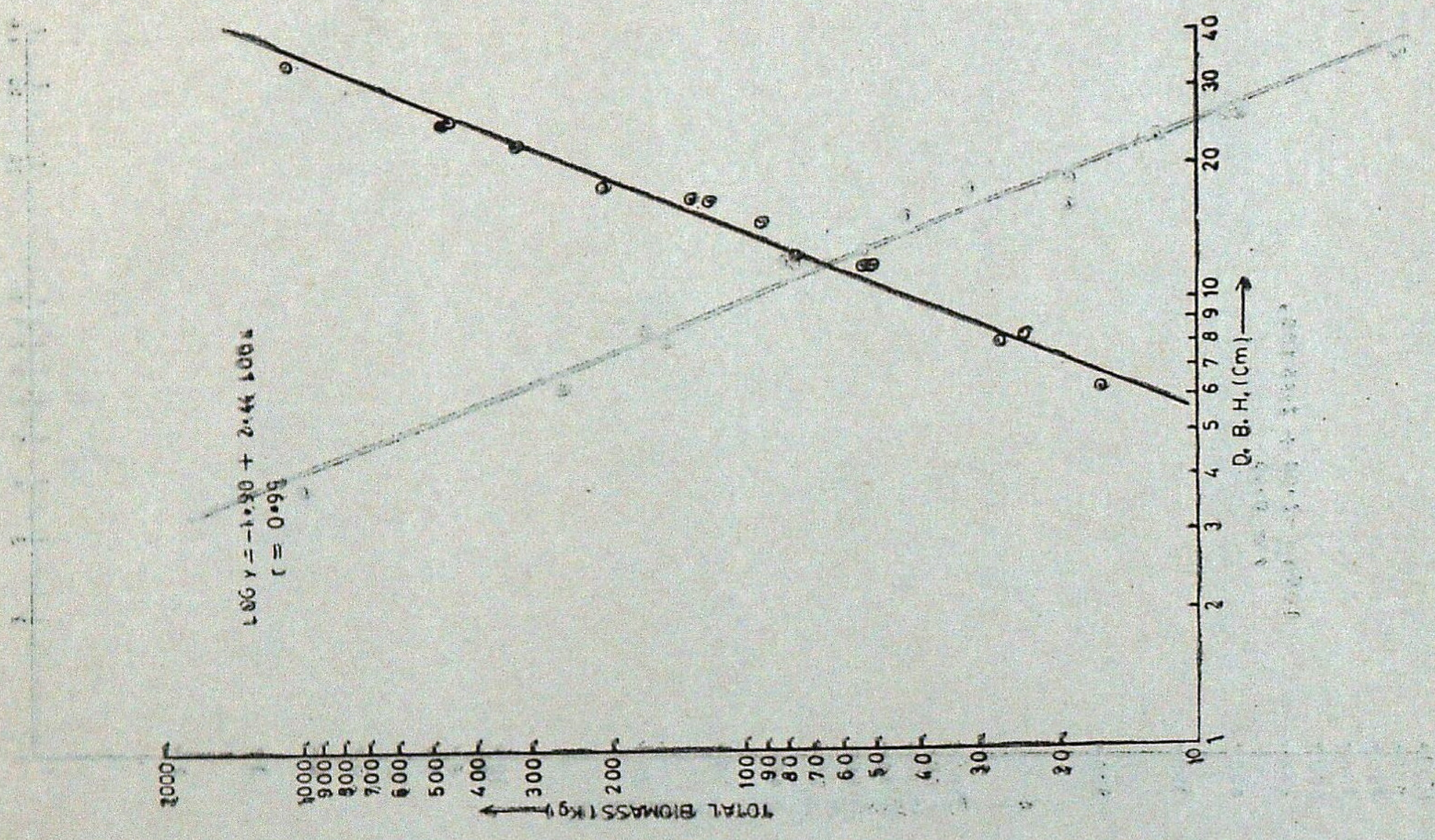
D.B.H. and total above-ground biomass.

Fig. 7



D.B.H. and Root weight.

Fig. 8



D.B.H. and total biomass.

Table 5

Multiple regression equations for all dependent variables
(Independent variables are DBH and Height)

Dependent variable (Y)	Regression equations (X_1 d.b.h. and X_2, height)	Multiple correlation coefficient (r)	Variance ratio with level of Significance
Bole weight	$Y = -9.1061 + 58.387\ X_1 - 32.8094\ X_2$	0.9583	67.4863 ***
Bark weight	$Y = -5.3341 + 3.9348\ X_1 - 1.8158\ X_2$	0.9694	93.5293 ***
Leaf weight	$Y = 0.6940 + 1.0799\ X_1 - 0.5724\ X_2$	0.9500	55.5645 ***
Twig weight	$Y = 0.0311 + 1.8403\ X_1 - 0.0917\ X_2$	0.9752	116.4954 ***
Branch weight	$Y = 5.8235 + 2.8239\ X_1 - 1.8325\ X_2$	0.9364	42.7019 ***
Total above-ground biomass	$Y = -7.8927 + 2.2647\ X_1 - 1.3743\ X_2$	0.9614	73.2355 ***
Root weight	$Y = -5.9960 + 1.8898\ X_1 - 0.9625\ X_2$	0.9678	88.8562 ***
Total biomass	$Y = -13.8857 + 72.4496\ X_1 - 39.9293\ X_2$	0.9629	76.4179 ***

*** Significant at 0.1% level

Table 6

Total standing biomass (kg/ha) of component plant parts of different aged plantations of Eucalyptus grandis

Age	Component plant parts							
	Bole	Bark	Leaf	Twig	Branch	Total above-ground biomass	Root	Total biomass
3	38406	4927	2627	3652	6720	56332	8465	64797
5	72574	9287	4532	4535	6693	97621	14918	112539
7	77718	7908	3126	2954	4800	96506	13467	109973
9	152063	17425	4687	4756	5443	184374	23241	207615
11	232436	20641	5575	5515	10883	275050	25514	300564

et al., 1984; Pande *et al.* (unpublished) for *Eucalyptus* stands. The percentage contribution of different components to above ground biomass reveals that the percentage of bole increases with increasing diameter and age from 68.3% (3 years) to 84.5% (11 years) whereas it decreases in case of other components except in bark where percentage contribution varies between 7.5 to 9.5.

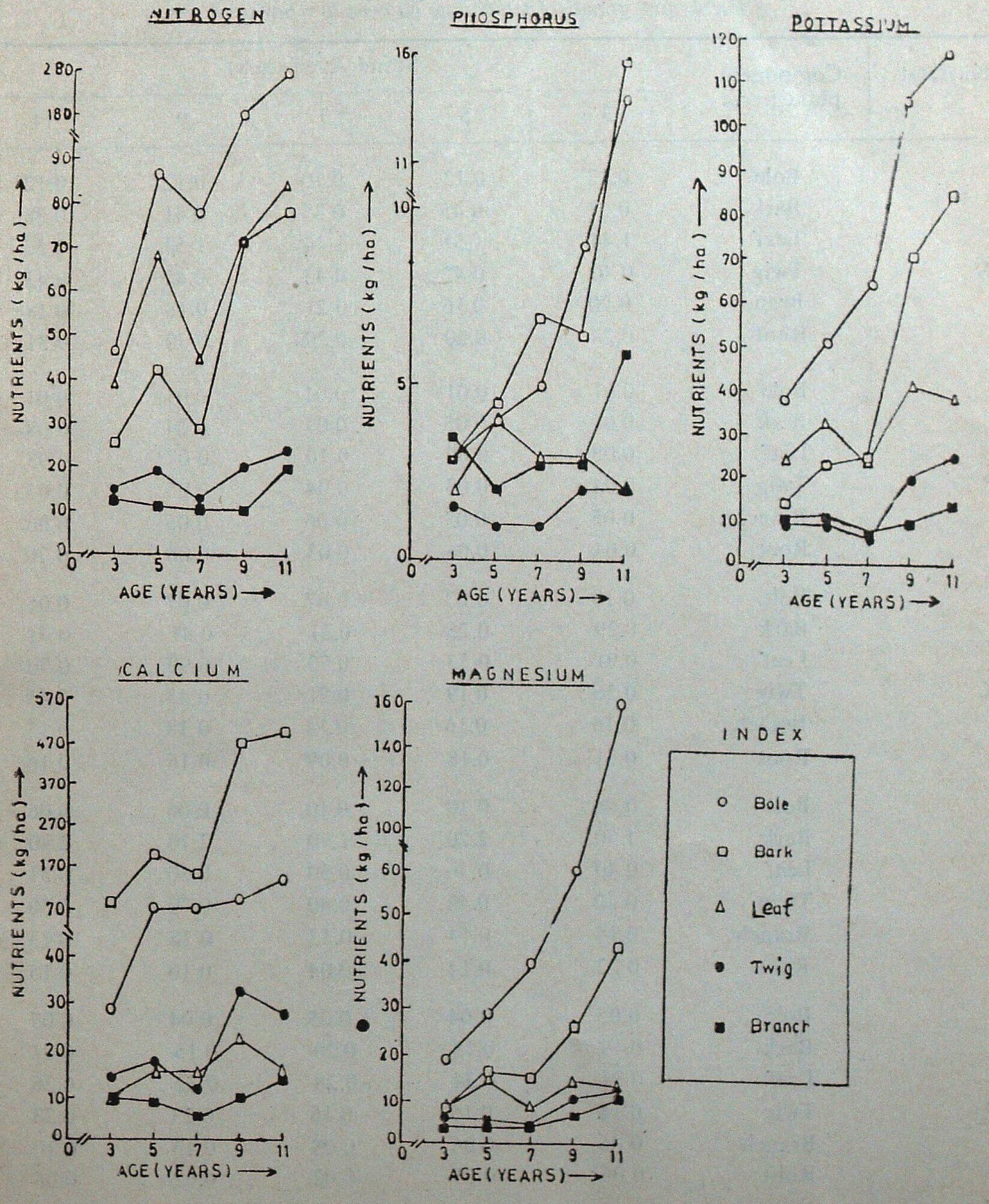
Concentration of nutrients: The average nutrient concentration as percentage on oven dry basis in different tree component at different ages is given in Table 7. In general, it is observed that leaf contains the highest percentage of N, P, K and Mg followed by bark, twigs and branches, except in case of P where the concentration is higher in branches as compared to twigs, while bark has the maximum concentration of Ca at all ages. Least concentration of nutrients is observed in bole at all ages. These results are in general agreement with those obtained earlier for *Eucalyptus* hybrid (George, 1977) in U.P., *Eucalyptus globulus* (Negi and Sharma, 1984) in Nilgiris, Tamil Nadu and *Eucalyptus* hybrid (Pande *et al.*, unpublished) in Karnataka.

Retention of nutrients: The total accumulation of nutrients by various biomass components is shown in Fig. 9. The nutrient contents of the standing crop differ substantially in various forest types according to the degree of uptake and crop biomass which in turn are affected by tree age and site quality even within the same species. The increase in nutrient contents of standing crop with stand age has a direct bearing on the total biomass of a forest stand (Ovington, 1959; Roddin & Bazilevich, 1967). As such the nutrient content accumulated in various tree component very considerably. The major portion of all the nutrients are accumulated in bole (N, 33% to 57%; P, 13% to 38%; K, 40% to 48% and Mg, 40% to 68%) while maximum Ca is held up in bark (57% to 75%).

Effect of the whole tree harvesting: Rennie (1955) for the first time, has drawn attention to the very considerable amount of nutrients immobilized in the crop and has questioned the ability of poorer soils to supply, over prolonged period the nutrient required to maintain continuous timber production. The present data shows that a considerable amount of nutrients are tied up in the aerial organs of the trees (Fig 10). Switzer & Nelson (1972) has suggested that some advantage could be gained over several rotations by leaving foliage on the site either by harvesting during the dormant season or by defoliating trees during the growing season. The present data indicates that leaving foliage on the site still results in relatively large amount of nutrients being removed. Harvesting of utilizable biomass (264 t/ha) at the age of 11 years would result in the removal of 0.38 0,05, 0.22, 0.65 and 0.22 t/ha of N, P, K, Ca and Mg respectively. As discussed earlier, maximum amount of Ca is accumulated in bark and debarking at the site will not only compensate the removal of Ca but also reduce the drain of other nutrients to some extent (N–78.44, P–6.62, K–71.44 and Mg–26.13 kg/ha).

Though the data on estimation of biomass at different ages, the regression equations for prediction of biomass by measuring the easiest parameter (D.B.H.) on a regional basis has been discussed in

Fig. 9



Total accumulation of nutrients in different tree components.

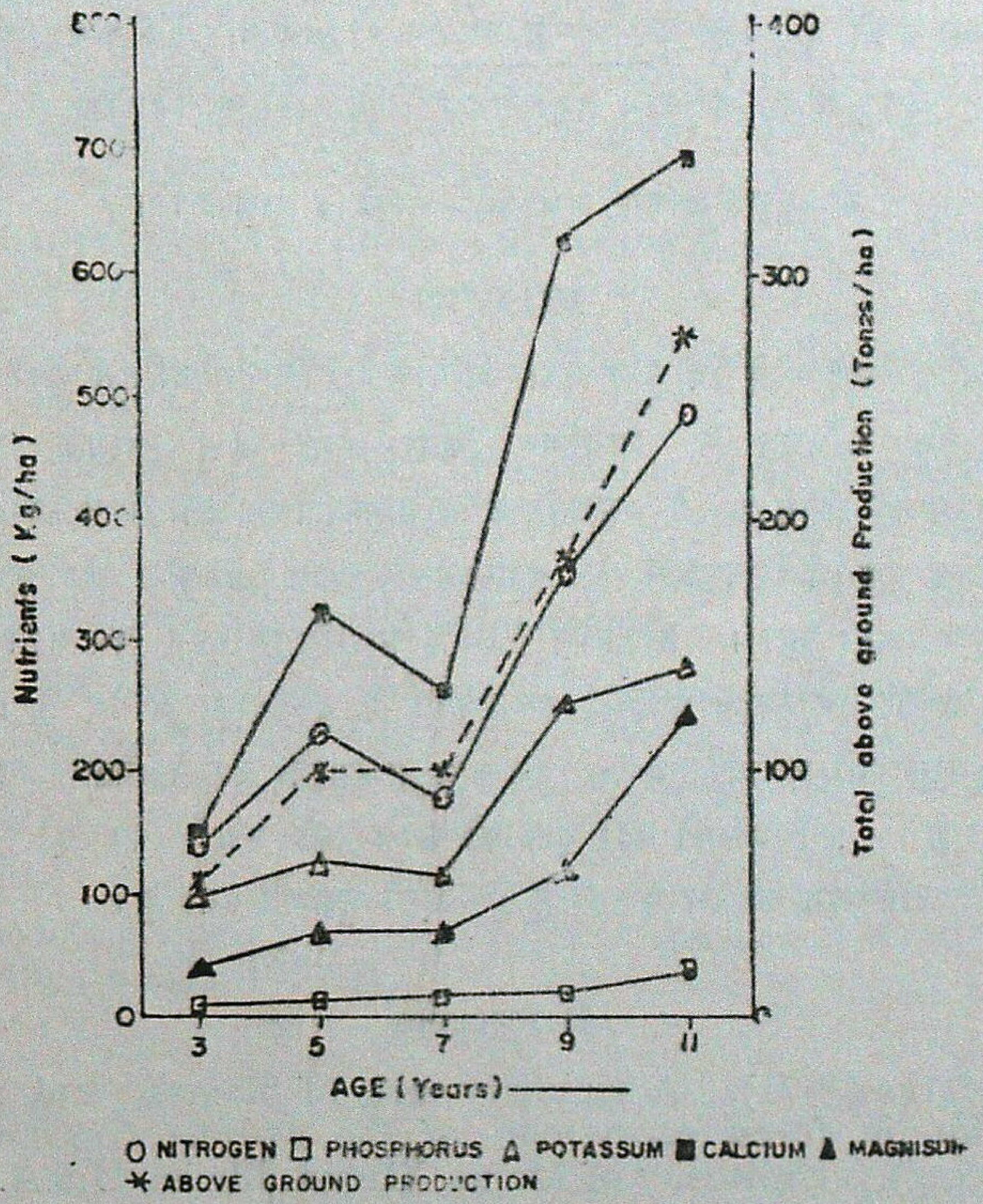
Table 7

Average nutrient concentration in different component plant parts of Eucalyptus grandis (percentage on oven dry basis)

Nutrient	Component plant parts	Stand Age (years)				
		3	5	7	9	11
N	Bole	0.12	0.12	0.10	0.12	0.12
	Bark	0.51	0.45	0.35	0.41	0.38
	Leaf	1.44	1.51	1.44	1.53	1.53
	Twig	0.40	0.42	0.43	0.42	0.43
	Branch	0.20	0.16	0.21	0.18	0.18
	Root	0.24	0.20	0.20	0 30	0.31
P	Bole	0.01	0.01	0 01	0.01	0.01
	Bark	0.06	0.05	0.09	0.04	0 08
	Leaf	0.08	0.09	0.10	0 07	0 08
	Twig	0.04	0.03	0.04	0.05	0.05
	Branch	0.05	0.03	0.06	0.05	0.06
	Root	0.04	0.06	0.03	0.06	0.70
K	Bole	0.10	0.07	0.07	0.07	0.05
	Bark	0.29	0.25	0.31	0.41	0.41
	Leaf	0.91	0.73	0.73	0.90	0.70
	Twig	0.26	0.19	0.21	0.43	0.45
	Branch	0.16	0.16	0.14	0.18	0.13
	Root	0.31	0.18	0.09	0.16	0.16
Ca	Bole	0.08	0.10	0.10	0.06	0.06
	Bark	1.70	2.20	1.90	2.70	2.40
	Leaf	0.40	0.36	0.50	0.50	0.31
	Twig	0.40	0.40	0.40	0.70	0.50
	Branch	0.15	0.14	0.13	0.18	0.13
	Root	0.22	0.14	0.04	0.10	0.15
Mg	Bole	0.05	0.04	0.05	0.04	0.07
	Bark	0.19	0.18	0.20	0.15	0.21
	Leaf	0.34	0.34	0.28	0.32	0.26
	Twig	0.18	0.15	0.16	0.23	0.23
	Branch	0.06	0.06	0.08	0.13	0.10
	Root	0.06	0.01	0.02	0.02	0.06

detail, it is not possible to conclude from the present data, as to what extent the site will be depleted as a result of whole tree harvesting, however there is an urgent need to establish the rate and amount of various nutrients that are removed from a variety of sites under short rotation systems as well as whole tree harvesting of older stands.

Fig. 10



Total retention of nutrients (kg/ha) and above-ground production (t/ha)

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SUMMARY

Above and below-ground biomass and distribution of nutrients of five different aged stands of *Eucalyptus grandis* have been discussed. Correlation coefficient and regression models were worked out separetely for each biomass component, total above-ground and total biomass. Among the predictor variables tried, D.B.H. was found to be the most reliable

parameter for prediction of biomass. The results were significant at 0.01% level of probability. The total standing biomass of these plantations ranges between 65 t/ha to 302 t/ha. An estimate has been made of the quantity of nutrients immobilized in the crop. The quantity of nutrients removed permanently from the site has also been discussed. Leaving foliage and debarking at the site has been suggested to check the deterioration of the site to some extent.

विभिन्न उम्रों की पांच युकेलिप्टस ग्रांडिस रोपवन परिस्थिति-सहतयों में
जैवपुंज का अनुमान तथा उनमे पोष्याहारों का वितरण

बी०एन० टण्डन, एम०सी० पाण्डे व राजेन्द्र सिंह

सारांश

धरती के ऊपर और उसके नीचे विभिन्न उम्रों के पांच युकेलिप्टस ग्रांडिस वनों का जैवपुंज, और उनके पोष्याहारों का वितरण इस अभिपत्र में विवेचित किया गया है। प्रत्येक जैवपुंज अवयव, धरती से ऊपर कुल जैवपुंज और कुल जैवपुंज में सहसंबन्ध गुणांक तथा प्रतीपायन प्रतिरूप अलग-अलग तैयार किए गए। इसमें परीक्षित संकेतज्ञ विचरों में से वृक्षोच्चता–व्यास जैवपुंज का पूर्व कथन करने के लिए सबसे अधिक विश्वसनीय परिमाप रहा। परिणाम 0.01% सभाव्यता स्तर पर साथक रहे। इन रोपवनों का वन में खड़ा कुल जैवपुंज 65 टन/हैक्टे० से 302 टन/हैक्टे० के दरम्यान आया है। फसल मे जमा हुई पोष्यहार–मात्रा का अनुमान भी लगाया गया। स्थल म से स्थायी रुप में निकल जाने वाली पोष्यहार–मात्रा का विवेचन भी किया गया है। पत्तियों को और वृक्ष की छाल को स्थल पर ही छोड़ देन से स्थल के विह्रास की कुछ सीमा तक रोकथाम की जा सकती है। ऐसा सुझाया गया है।

References

Art, H.W. and P.L. Marks (1971). A summary table of biomass and net annual primary production in forest ecosystems of the world. *Forest Biomass Studies* (Ed. H.E. Young). University of Maine, Orono, Maine, U.S.A.

Basha, S. Chand (1984). Performence of *Eucalyptus* in Kerala *Proc.* of the *National Seminar* on Eucalypts in Ind. Forestry Peechi, Kerala : 71-76.

Champion, H.G. and S.K. Seth (1968). A revised survey of forest types of India. Manager of Publications, Delhi.

Cromer, R.N., M. Raupach, A.R.P. Clarks and J.N. Cameron (1976). *Eucalyptus* plantations in Australia. The potential for intensive production and utilization. *Oslo biomass studies*, College of Life Science and Agriculture, Uni. of Maine, Orono, Maine, U.S.A. : 165-173.

George, M. (1977). Organic productivity and nutrient cycling in *Eucalyptus* hybrid plantation. *Ph. D. Thesis*, Meerut University, Meerut.

Hingston, F.J., G.M. Dimmock and A.G. Turton (1981). Nutrient distribution in a Jarrah (*Eucalyptus marginata* Donn. Exsm.) ecosystem in South-Western Australia. *Forest Ecol. and Management* 3 : 183-207.

Kushalappa, K.A. (1984). Biomass of Mysore gum trees in Jedigenahally, Karnataka. *Indian For.*, **110** (9) : 854-806.

Negi, J.D.S., N.K.S. Bora, V.N. Tandon and H.D. Thapliyal (1984). Distribution of organic matter in an age series of *Eucalyptus globulus* plantation in Tamil Nadu. *Indian For.* **110** (8) : 802-813.

Negi, J.D.S. and D.C. Sharma (1984). Distribution of nutrient in an age series of *Eucalyptus globulus* plantation in Tamil Nadu. *Indian For.*, **110** (9) : 944-953.

Ovington, J.D. (1959). The circulation of minerals in plantation of *Pinus sylvestris*. *Ann. Bot*. 23 : 229 239.

Pande, M.C., V.N. Tandon and H.S. Rawat (unpublished). Organic matter production and distribution of nutrients in *Eucalyptus* hybrid plantation ecosystems in Karnataka. Submitted Jan., 1987.

Rai, S.N. (1984). Above-ground biomass in tropical rain forests of Western Ghat. *Indian For.*, **110** (8) : 754-764.

Rennie, P.J. (1955). The uptake of nutrients by Mature Forest Growth. *Plant and soil.* VII : 49-95.

Roddin, L.E. and N.L. Bazilevich (1967). Production and mineral cycling in Terrestrial Vegetation, Oliver and Boyd. Edinburgh/London, 288 pp.

Schonau, A.P.G. and D.I. Boden (1981). Perliminary biomass studies in young *Eucalyptus* XVII *Iufro World Congress* Kyoto, Japan.

Singh, R.P. and V.K. Sharma (1976). Biamass estimation in five different aged plantations of *Eucalyptus tereticornis* Smith. in Western Uttar Pradesh. *Osla Biomass Studies*, College of Life Science and Agriuclture. Uni. of Maine, Orono, U.S.A., 145-161.

Switzer, G.L. and L.E. Nelson (1972). Nutrient accumulation and cycling in Loblolly pine (*Pinus teada* L.) plantation ecosystems : the first twenty years *Soil. Sci. Sec. Am. Proc.* 36 (1) : 143-147.

HETEROPSYLLA CUBANA CRAWFORD, A NEW PSYLLID PEST OF *LEUCAENA* IN INDIA

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Introduction

Director, Centre for Plant Protection Studies, Tamil Nadu Agricultural University vide his letter dated 29th Feb., 1988 has reported that his entomologist has noticed the occurrence of psyllids in *Leucaena* plantations in their Livestock Research Station, Kattupakkam, Chengalpettu District near Madras. An immediate intensified survey in other parts of Tamil Nadu by CPPS entomologist has recorded the psyllids from Pudukottai, Trichy and Coimbatore districts also. The new psyllid causing damage to *Leucaena* was identified as *Heteropsylla cubana* Crawford by the authors. This is the worst thing that could happen to *Leucaena* in this country.

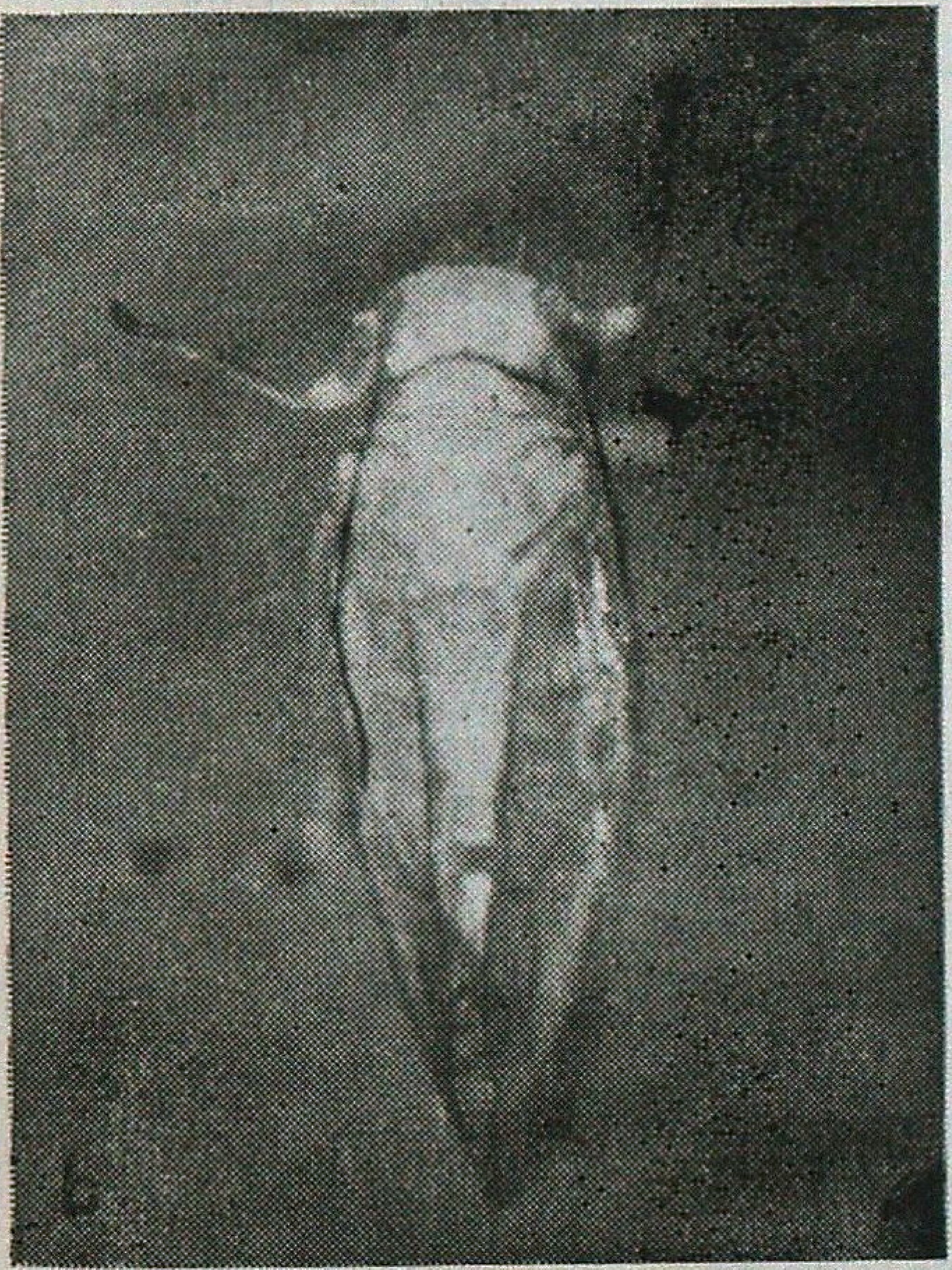
The pest (Figs. a, b and c)

Heteropsylla cubana Crawford (Hemiptera : Psyllidae) is a tiny insect belonging to the group called, the jumping plant lice. Eggs are laid on the tissue of host plant, found massed in large numbers on young twigs and leaves of the host including buds. The colour of egg is white to yellowish. After hatching from the egg, the First stage psyllid nymph searches out a suitable site for the insertion of its feeding stylets. There are 5 nymphal instars in the life-cycle. In tropical climate they have perhaps as many as 8-10 generations per year. The nymphs feed primarily on tender growth and the heaviest infestations normally are associated with new flush of leaves. Psyllid nymphs are soft bodied pale yellowish in colour. Wing pads which become the fully developed wing in adult increase in size with each moult and are most prominent in the last nymphal instar.

Fig. a

Adult : feeding on Su-babul.

Fig. b



Adult : Dorsalview.

Fig. c

Nymphs : Feeding on Su-babul.

Leucaena psyllid : *Heteropsylla cubana* Crawford.

Host plants

In addition to *Leucaena leucocephala*, the other recorded host plants of *H. cubana* are *L. diversifolia*, *L. esculenta*, *L. greggii*, *L. lanceolata*, *L. macrophylla*, *L. pulverulenta*, *L. retusa*, *L. shannoni*, *L. trichodes* and *Samanea saman* (Sorensson *et al.*, 1986; Mitchell *et al.*, 1986).

Damage

Leucaena psyllid lays eggs on new foliage of several plant species but the nymphs differentiate and feed only on very young *Leucaena* foliage. Eggs are not laid on old foliage. But adult may suck the sap of old leaves. Nymphs do heavy damage to young leaflets which can become covered with a sticky honeydew like substance curl and die. Heavy infestation leads to defoliation and die-back and death of plants.

Distribution of *H. cubana*

The original distribution of *H. cubana* appears to have been around Cuba and the Caribbean. *H. cubana* has also been recorded from Argentina, Bahama Islands, Bermuda, Cuba, Dominican Republic, Guadeloupe, Nicaragua, Mexico and Peru (Mitchel *et al.*, 1986); El Salvador, Panama & Surinam (Brown, 1985). *Leucaena* psyllids are known throughout the Caribbean and along the coast of Mexico where they appear to have an effec ive natural regulating mechanism. They rarely cause severe defoliation.

Spread of *H. cubana*

Leucaena has been introduced as a fodder crop in various countries of the world. For a long time it was free in its new homes from the native insect pests of the species. For the first-time *H. cubana* was

reported from Hawaii in 1984 (Othman and Prine, 1984; Sorensson and Brewbaker, 1984). Then the spread of the psyllid across the Pacific Ocean occurred very rapidly. In February, 1984 the psyllid was reported damaging *Leucaena* in Western Samoa (Hollingsworth, *et al.*, 1985). McFadden (1986) reported its presence in Philippines in February and serious defoliation occurred in March, 1985. The Cook Islands, Fiji and Niue Islands were infested in June, 1985. Tonga, Vanuatu and Yap reported the psyllid in July, 1983. The psyllid was first observed in New Caledonia at the end of 1984 (McFadden, 1986). American Samoa and Solomon Islands reported infestation in November and December, 1984 respectively. The psyllid was first found in Eastern Taiwan in the summer of 1985 (Mitchell *et al.*, 1986). In Indonesia the psyllid was first recorded in Bogar in March, 1986, and within three months it spread all over Java, Sumatra, Bali, Flores, Sulawesi etc. (Mitchell *et al.*, 1986). The psyllid is found from sea level up to 3000 m elevation in New Guinea. It was found on New Britain, Bougainville and New Ireland in early March, 1986. The psyllid was first reported in Australia in 1986 (Mitchell *et al.*, 1986). Christmas Island in the Indian Ocean reported the infestation of *H. cubana* in May, 1986 (Mitchell *et al.*, 1986). There have been unconfirmed reports of psyllids attacking *leucaena* in Malaysia (Mitchell *et al.*, 1986). Psyllids were observed in Thailand in September, 1986 (Brewbaker, unpublished). In 1986 the psyllid was reported from Sri Lanka (LRR August, 1987). In February, 1988 the pest was first reported from India.

The spread of psyllid across the Pacific Ocean occurred very rapidly. How the psyllid could go so great a distance in such a short time, less than 2 years has been puzzling entomologists. Some entomologists believe the insects were carried by large air masses such as the jet stream at higher elevation. Some believe that adult psyllids are strongly attracted to light, flew on to the air-crafts being loaded at night. Evidence is lacking to confirm the either theory. It is doubtfull that the infested plant material could have been the source of material (Mitchell *et al.*, 1986).

Once the psyllid has entered this sub-continent it is only a matter of time that the pest will spread throughout the country wherever *Leucaena* grows. It also attacks the rain tree, *Samanea saman* which will also be affected. As soon as this psyllid is detected anywhere, the immediate action should be to destroy it by chemical sprays i.e., 0.1% fenitrothion and 0.04% phosphamidon. But once it has established itself in the sub-continent, this measure may not succeed.

Resistance to *Leucaena* species

L. collinsii and *L. pallida* are immune to *H. cubana* (Sorensson and Brewbaker, 1986). Some varieties of *L. leucocephala* and other *Leucaena* species offer varying resistance to the psyllid. Resistance is evident in some provenances of *L. escullenta.* Some provenances of *L. retusa* are either tolerant or resistant. Field tolerance in some provenances of *L. leucocephala* and *L. diversifolia* has been observed (Sorensson *et al.*, 1986). The *L. leucocephala* varieties that show high resistance in Hawaii are k527, k538, k591, k656 and k658. Will the resistance be durable ? Nothing

can be predicted with accuracy, but it's likely because *Leucaena* is a polyploid (2n=104) in which monogenic resistance ("gene-for-gene") is unexpected. All sources of resistance involve failure of eggs to hatch and of nymphs to mature normally, adult feeding and oviposition seem unaffected (Anon., 1986).

Biological control

Since parasites and predators of psyllids are common and have provided effective control in the Caribbean for years' introducing parasites and predators could help solve the problem. Natural enemies of *H. cubana* have been investigated by Nakahara and Funasaki (1987). The results of their investigation are given below.

Outstanding predators in Hawaii are the lady bird beetles *Curinus coeruleus* Mulsant and *Olla abdominalis* (Say). The larvae of these beetles are the prominent feeders of nymphs and adults. *C. coerulells* is a general predator and was first introduced into Hawaii in 1922 from Mexico to control the coconut mealybug. This beetle has been introduced in some countries for the control of *Leucaena* psyllid. The native home of the psyllid may be intensively

Table 1

Natural enemies of Heteropsylla cubana.

Trinidad and Tobago	
Parasites	
Hymenoptera	
Encyrtidae	*Psyllaephagus* sp. nr. *rotundiformis*
Eulophidae	(Howard) *Tetrastichus triozae* (Burks)
Predators	
Coleoptera	
Coccinellidae	*Cycloneda conjugata* Mulsant
Hawaii	
Predators	
Arachnida	Various unidentified spiders
Coleoptera	
Coccinellidae	*Coelophora pupillata* (Swartz)
	Curinus coeruleus Mulsant
	Olla abdominalis (Say)
Diptera	
Syrphidae	Unidentified syrphid larvae
Hemiptera	
Anthocoridae	*Paratriphleps laevisculus* Champion
Miridae	*Rhinacloa forticornis* Reuter
Reduviidae	*Zelus renardii* Kolenati
Neuroptera	
Chrysopidae	Unidentified green lacewing

explored for parasites predators and pathogens for introduction in the new homes of *Leucaena* psyllid to keep its population under tolerance level.

Conclusions

The introduction of *Leucaena* psyllid in the Indian sub-continent is fraught with danger for the cultivation of *Leucaena*. Chemical control may not succeed as the psyllid already appears to have established in the southern tip of the peninsular India. Investigations should be made to search psyllid resistant/tolerant varieties/hybrid for planting in place of susceptible varieties/species. Investigations should be carried out for the introduction of biological control agents for keeping this psyllid scourge under check. An All-India research project for *Leucaena* psyllid control should be prepared by Research Organisations carrying out Research on *Leucaena* in the country and Wasteland Development Board or these organisations should participate in a 'Regional Research Plan for *Leucaena* psyllid control' as developed by Napompeth, *et al.*, 1987.

SUMMARY

Leucaena **psyllid,** ***Heteropsylla cubana*** **was detected in February, 1988 by an entomologist, of Tamil Nadu Agricultural University in Chingalpettu District. A survey undertaken soon after, recorded the psyllid from Pudukottai, Trichi and Coimbatore districts also.** ***Leucaena*** **cultivation is threatened. The psyllid is native of Caribbean region. In a short span of 2 years since 1984 it had spread all over the Pacific basin and crossed over to Indian Ocean basin, reaching Sri Lanka in 1986. Biological-cum-genetic control measures should be launched by releasing in India promising parasites, predators and pathogens from the native home of the pest and raising psyllid resistant varieties of** ***L. leucocephala*** **or species of** ***Leucaena*****. An all India project for** ***Leucaena*** **psyllid control should be prepared with the participation of Wasteland Development Board and various other research organisations or India should participate in the Regional Plan for Psyllid Control prepared by FRED Project**

भारत म ल्यूसेना का नया साइलिड नाशिकीट— हिटरोसाइला कूबाना क्राफर्ड

प्रताप सिंह

सारांश

ल्यूमेना साइलिड, हिटरोमाइला कूबाना पहले-पहल तमिलनाडु कृषि विश्वविद्यालय के एक कीट विज्ञानी द्वारा 1988 में त्रिगलपट्टु जिले मे देखा गया। इसके तुरन्त बाद किए गए सर्वेक्षण में बह साइलिड पुद्दुकोटई, त्रिची और कोयम्बटूर जिलों मे भी मिला। इससे ल्यूमेना की कृषि को खतरा हो गया है। यह साइलिड केरिबियन क्षेत्र का मूलवासी है। 1984 से दो वर्षो की अल्पावधि में ही यह पूरे प्रशान्त महासागर क्षेत्र में फैल गया और फिर उसे पार कर हिन्दमहासागर में आया तथा 1986 में श्रीलंका पहुंचा। इसके जैविकीय-व-आनुवांशशिकीय नियन्त्रण उपाय इसके मूल देश में से इसके उत्साहप्रद परजीवी कीट, सिंहक कीट और रोगोत्पादक कवक लाकर और उन्हें भारत में फैलाकर तथा ल्यूमेना ल्यूकोकेफेला के इस साइलड प्रतिरोधी

विभेद अथवा ल्युसेना प्रजाति की यह साइलिड प्रतिरोधी जातियां विकसित करके किये जाने चाहिए। बंजर भूमि विकास मण्डल तथा विभिन्न अन्य अनुसन्धान संगटनो का सहयोग लेकर ल्युसेना साइलिड के नियन्त्रण की अखिल भारतीय परियोजना बनाई जानी चाहिए अथवा भारत को एफआरईडी परियोजना द्वारा इस साइलिड के नियन्त्रण के लिए बनाई गई क्षेत्रीय योजना में सहयोगी बन जाना चाहिए।

References

Anonymous (1986). *Laucaena* psyllids - The problem and proposed solution. NFT Highlights, 2 pp.

.... (1987). Foreword to volume 8. "*Leucaena Research Reports*, ii-iii.

Brown, R.G. (1985). Studies on the Taxonomy and Ecology of the Jumping Plant Lice (Homoptera : Psylloidea) of Panama. Doctoral dissertation for the Council for National Awards, Department of Biology, Liverpool Polytechnic; Department of Entomology, British Museum (Natural History).

Hollingsworth, R.G. ; R.L. Thomas & W. Liebregts (1985). New Psyllid Pest on *Leucaena* in Western Samoa. *Leucaena Research Report*, **6** : 100–102.

McFadden, M.W. (1986). Evaluation of the *Leucaena/Heteropsylla* problem in Hawaii, the Philippines and New Caledonia. *Forestry Support Program, USDA Forest Service*, Washington, DC.

Mitchell, W.C. & D.F. Waterhouse (1986). Spread of the *Leucaena* psyllid, *Heteropsylla cubana* in the Pacific. *Leucaena Research Report*, **7** : 6–8.

Nakahara, L.M. and R.Y. Funasaki (1986). Natural enemies of the *Leucaena* psyllid, *Heteropsylla cubana* Crawford (Homoptera : Psyllidae). *LRR* **7** : 9–12.

Napompeth, B., K.G. MacDicken, M McFadden and I.N. Oka (1987). A Regional Research Plan for *Leucaena* psyllid control, F/FRED Project, 61 pp.

Othman, A.B. & G.M. Prine (1984). *Leucaena* Accessions Resistant to Jumping Plant Lice. *Leucaena Research Report*, **5** : 86-87.

Sorensson, C.T. & J.L. Brewbaker (1984). Newly introduced psyllid in Hawaii injurious to *Leucaena*. *LRR*, **5** : 91 93.

....(1986). Resistance of *Leucaena* species and hybrids. *Leucaena Research Reports*, **7** : 13-15.

PLYWOOD FROM INDIAN TIMBERS : *ALNUS NITIDA* (ALDER)

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Introduction

Alnus nitida (Alder) is a very large tree with girths of about 4–4.75 m and height 36-40 m and is frequently found along roadsides in Punjab, Jammu & Kashmir and Himachal Pradesh in moist places and inner valleys. The stem is moderately straight, often with low branches. The wood is reported to be very light (Sp. gr. 0.43), fairly straight grained, medium fine and quite even tex:ured. Basic data on its seasoning behaviour, durability, treatability, wood working qualities and the physical and mechanical properties is lacking. However, it is used to a limited extent for building purposes and for other petty uses where better timbers are not available. It is also used in match industry although it is reported to yield inferior match-splints (Pearson and Brown; 1932).

Alder is recommended for use in making plywood for general purpose only (IS : 303-1975). Information on its suitability for other grades of plywood viz., plywood for concrete shuttering works, preservative treated plywood, marine plywood etc., is not available. Further, even for general purpose plywood, the information on some of the individual species like *Alnus nitida*, *Alnus nepalensis* etc., is also not available. It was therefore considered worthwhile to investigate the individual species and the present studies aim at *Alnus nitida* received from Himachal Pradesh.

Experimental

(i) *Veneer making* : Logs for the studies were obtained from Pool Patli Kuhl Range, Kulu Division, Manali Road, Himachal Pradesh. Logs were cut into peeler size and dipped in the cold water pit for about a month so that the logs gained sufficient moisture before veneering. Logs were peeled at room temperature. Peeling lathe settings were as follows for 1.6 mm thick veneer production :

Knife angle	—	91.2°
Vertical gap between knife and pressure bar	—	0.38 mm
Horizontal gap between knife and pressure bar	—	1.524 mm
Speed of peeling	—	30.48 m/min

The veneers so obtained were dried in Merrit dryer maintaining temperature of about 140 ± 5°C to bring down their moisture content between 8–12 per cent. Dried veneers were then utilised for making plywood for further testing.

(ii) *Preparation of plywood using U-F and P-F adhesives* : Plywood samples of the size 60×60 cm, 3-ply, using 1.6 mm thick veneers and urea-formaldehyde and phenol-formaldehyde glues were prepared for further testing. Method of preparing the U-F and P-F glue in the laboratory was

Table 1

Physical and Mechanical properties of plywood bonded with U-F and P-F glue

			U-F bonded plywood 3-ply contruction			P-F bonded plywood 3-ply construction			P-F bonded plywood for concrete shuttering work 3-ply construction		
			Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.
1	2		3	4	5	6	7	8	9	10	11
1.	Moisture content %		8.13	8.35	7.52	7.40	8.00	7.00	7.69	8.40	6.86
2.	Glue shear strength										
	Dry	F.L. kg	169.3	181.4	158.8	186.0	199.6	172.4	203.4	213.2	190.5
		G.F.%	0	0	0	0	0	0	0	0	0
	Boiling water proof (72 hr. boiling)	F.L. kg	—	—	—	114.2	127.0	104.3	148.2	181.4	127.0
		G.F.%	—	—	—	0	0	0	0	0	0
	Boiling water resistance (8 hr boiling)	F.L. kg	—	—	—	147.4	163.3	127.0	169.7	181.4	154.2
		G.F.%	—	—	—	0	0	0	0	0	0
	Warm water resistance (70°C for 3 hr.)	F.L. kg	153.5	172.4	131.5	—	—	—	—	—	—
		G.F.%	0	0	0	—	—	—	—	—	—
	Cold water resistance (27°C for 24 hr)	F.L. kg	145.9	181.4	127.0	—	—	—	—	—	—
		G.F.%	0	0	0	—	—	—	—	—	—
	Mycological test	F.L. kg	120.2	136.1	99.8	130.8	140.6	117.9	132.3	145.2	122.5
		G.F.%	0	0	0	0	0	0	0	0	0

(*Contd...*)

1	2	3	4	5	6	7	8	9	10	11
3. Modulus of rupture (MOR) kg/cm²	Parallel to grain	876.6	918.7	858.1	845.4	930.2	809.0	1021.3	1091.5	1000.6
	Perpendicular to grain	113.0	144.2	83.7	140.8	157.4	111.6	225.7	272.9	181.9
4. Modulus of Elasticity (MOE) $\times 10^{10}$ dynes/cm²	Parallel to grain	1.188	1.330	1.100	1.410	1.480	1.320	1.685	1.830	1.540
	Perpendicular to grain	0.428	0.470	0.370	0.543	0.570	0.520	0.650	0.740	0.600
5. Tensile strength (kg/cm²)	Parallel to grain	629.7	678.0	586.5	694.2	743.1	645.0	828.2	885.2	744.2
	Perpendicular to grain	312.0	315.1	304.0	424.1	506.2	347.3	434.3	523.6	300.8
	Parallel + Perpendicular to grain	941.7	993.1	890.5	1118.3	1249.3	992.2	1262.5	1408.8	1045.0
6. Compressive strength (kg/cm²)	Parallel to grain	510.2	578.8	472.9	507.4	537.5	463.0	596.7	628.4	557.3
	Perpendicular to grain	275.5	300.0	248.1	326.3	354.7	297.7	437.1	466.7	405.3

similar to that suggested by George (1977) and reported in an earlier publication (Shukla *et al.*, 1985). Extenders or fillers were not added in the glue. Details are as follows :

Thickness of veneer—1.6 mm
No. of ply —3-ply construction.
Glue spread —95-115 g/m² of single glue line.
Pressure —14 kg/cm².
Temperature—150 C for P-F resin and 100 ± 2°C for U-F resin.
Press time —10 minutes.

For making concrete shuttering grade plywood, surface veneers were also given a thick coating of P-F resin which was cured simultaneously during pressing on each face.

For carrying out preservative and preservative-cum-fire retardant treatments, 3 and 5-ply, plywood was prepared using P-F adhesive. Method of preparation was similar to that of general purpose plywood except that to compensate for increased thickness, time of pressing was increased to 15 minutes in case of 5-ply plywood.

(iii) *Preservative treatment of plywood* : Plywood samples conditioned at room temperature were converted into specimens of the size 15.0 × 8.0 × 0.78 cm for further testing. Sides of the specimens were sealed with rubberised paint so that during treatment, solution penetrates through the surfaces only and the conditions simulate those of treatment of full size panels. 4% CCA (copper-chrome-arsenic) solution (IS : 10013-1981), was used for treatment following the vacuum pressure technique.

An initial vacuum of about 45 cm of mercury was applied for 30 minutes in all cases. Two pressure levels, 2 and 3 kg/cm², were used and the duration of treatment for each pressure cycle was varied to 15, 30, 45 and 60 minutes. Each specimen was weighed before and after treatment for working out dry-salt absorption. In each set a minimum of 3 specimens were treated. The depth of penetration of preservative in the specimens was ascertained by spot test as per IS : 401-1982. Observations are recorded in Table 2.

(iv) *Fire retardant treatment* : For adequate protection against fire higher doses of the chemicals ranging from 18–23 kg/m³ are required. Since in preservative treatment, loading achieved with 4.0 per cent solution at 2 kg/cm² pressure for 15 minutes were 15.98 to 19.80 kg/m³, two concentrations, 4 and 6 per cent, were used in the treatment. The composition contained ammonium phosphate 4 parts, copper sulphate 1 part and sodium dichromate 1 part. Procedure followed for the treatment was the same as in case of preservative treatment. Absorptions obtained are reported in Table 2.

(v) *Blockboard* : Blockboards were prepared using both U-F and P-F glues for testing the suitability of *Alnus nitida* (Alder) for interior (grade II) and exterior (grade I) purposes. Strips of 25.0 × 25.0 mm, cross-section for the purpose were prepared and air-dried (MC 10 - 15 per cent). These were dipped for 3 hours in 1.5 per cent boric acid solution. Treated strips had an absorption of about 2.1 kg/m³. Strips were then again dried to a MC of about 8–12 per cent. Blockboards having 5-ply assembly with wood strips as core were prepared keeping temperature and pressure conditions similar to that used in plywood preparation except that the time

Table 2

Results of preservative-cum-fire retardant treated plywood (P-F bonded).

Treatment : Initial vacuum 40-50 cm of Hg for 30 min.		Absorption of preservative (4%) or fire retardant (+) (6%) — (dry salt kg/m³)	
Pressure kg/cm	Period (min)	3-ply	5-ply
2	15	19.80	15.98
2	30	20 35	18.50
2	45	21.91	19.74
2	60	22.40	20.69
3	15	20.44	17.89
3	30	20.86	20.34
3	45	23 25	22.16
3	60	23.25	23.56
2	15	33 21 (*)	32.80 (*)

Note : Full penetration was observed in treated specimens.

of pressing was increased to 20 minutes. Longer pressure cycle under heat generally help in removing wavyness, a surface defect which warrants heavy sanding during thicknessing.

Testing of plywood and blockboard : The following tests were carried out on U-F and P-F bonded plywood samples as per IS : 1734, Part I to XX–1983,

(i) Moisture content (Part I).

(ii) Glue adhesion in dry state, glue shear strength (Part IV).

(iii) Water resistance (Appendix B–IS : 303-1975), and glue shear strength in wet state (Part VIII).

(iv) Mycological test, glue shear strength (Part VII).

(v) Tensile strength (Part IX).

(vi) Bending strength (Part X)

On blockboards, undermentioned tests were conducted :

(i) Water resistance test (72 hours soaking in boiling water for grade I (P-F bonded) and 3 hours soaking in water at 70° ± 2°C for grade II (U-F bonded blockboards).

(ii) Mycological test.

(iii) Test for adhesion of plies.

Plywood prepared with P-F glue and treated with preservative or preservative-cum-fire retardant chemicals was also tested for its glue adhesion strength in dry and wet state to assess the effect of chemicals on glue bond. Tests were carried out on only those samples which had the required retentions of preservatives or fire retardant chemicals. Test results are reported in Table 3.

Results and Discussion

(i) *Glue shear strength in dry state* : Glue shear strength values, avg., and min., for BWP and BWR grades of plywood are 1323.9N (135 kg) and 1078.7N (110 kg) for

Table 3

Glue shear strength of preservative-cum-fire retardant treated 3-play plywood (P-F bonded)

Test		Glue shear strength. Failing load (kg)		
		Avg.	Max.	Min.
Control	Dry	187.5	195.0	181.4
	Wet	163.2	167.8	158.7
Preservative treated.	Dry	170.8	176.9	163.2
	Wet	179.9	195.0	163.2
Fire-retardant treated.	Dry	175.3	181.4	167.8
	Wet	173.8	195.0	154.2

Note :— No glue failure was observed.

WWR grade plywood 980.7N (100 kg) and 784.5N-(80 kg) and for CWR grade plywood 686.5N (70 kg) and 539.4N (55 kg) respectively. The avg., and min., values reported in Table 1 for U-F bonded plywood are 1660.7N (16.3 kg) and 1556.9N (158.7 kg) and for P-F bonded plywood are 1823.8N (186.0N kg) and 1690.4N (172.4 k) which are much higher to the specified values (IS : 303-1973) for BWP, BWR, WWR and CWR grades of plywood.

(ii) *Glue shear strength in water resistance test* : The glue shear strength values in wet state, avg., and min., specified for BWP and BWR grade plywood are 980 7N (100 kg) and 784.5N (80 kg), for WWR grade 784 5N (80 kg) and 637.0N (65 kg) and for CWR grade 343.0N (35 kg) and 294.0N (30 kg). The values reported in Table 1 are for BWP grade 1119.5N (114.2 kg) and 1023.1N (104 3 kg), for BWR grade 1445.7N (147.4 kg) and 1245.5N (127.0 kg), for WWR grade 1505.0N (153.5 kg) and 1290.0N (131.5 kg) and for CWR grade 1430.9N (145.9 kg) and 1245.5N (127.0 kg) which meet the requirements of general purpose plywood (IS : 303-1975).

(iii) *Glue shear strength in mycological test* : The glue shear strength values, avg., and min., specified for BWP, BWR and CWR grade plywood in mycological tests are similar to those specified for water resistance test described earlier. The values reported in Table 1 for P-F bonded plywood are 1282.6N (130.8 kg) and 1156.6N (117.9 kg), and for U-F bonded plywood 1178.8N (120.2 kg) and 978.6N (99.8 kg) respectively which meet the requirements of IS : 303-1975 for general purposes plywood.

(iv) *Tensile strength* : Tensile strength values are specified for marine plywood (IS : 710-1976) and for plywood for concerte shuttering work (IS : 4990-1981). The values obtained for P-F bonded plywood (Table 1) parallel to grain 694.2 kgf/cm² and perpendicular to grain 424.1 kgf/cm² and their some equal to 1118.3 kgf/cm². These values are much higher to the require-

ments for shuttering grade plywood parallel to grain 420 kg^f/cm^2, perpendicular to grain 250 kg^f/cm^2, sum 845 kg^f/cm^2 and thus meet the requirements for the above two categories of the plywood.

(v) *Bending strength and compressive strength* : Since the bending strength values (modulus of elasticity and modulus of rupture) and compressive strength values are of much significance for designing/constructional purposes, these values for plywood prepared fram U-F as well as P-F were also determined and reported in Table 1.

(vi) *Suitability for concrete shuttering works* : Test results for plywood for concrete shuttering works are given in the last column of Table 1. The glue shear strength values, avg , and min , obtained in dry state are 203.4 kg and 190.5 kg and in wet state (8 hr boiling water test) 169.7 kg and 154.2 kg respectively. The values prescribed (IS : 4990-1981) are, avg., 135 kg with no individual value less than 110 kg in dry test and 100 kg and 80 kg in the two water resistance tests respectively. Specimens did not show any sign of checking, cracking or delamination in 72 hr boiling test. Glue shear strength values obtained in wet state are 148.2 kg (avg) and 127.0 kg (min). In mycological test, values obtained are, avg., 132.3 kg and min , 122.5 kg which are much higher when compared to specified values 100 kg and 80 kg, avg., and min., respectively.

Tensile strength values obtained are parallel to grain 828.2 kg^f/cm^2 and perpendicular to grain 434.3 kg^f/cm^2 and their sum-1262.5 kg^f/cm^2. The values obtained are much higher than those specified for parallel, perpendicular and sum, 325, 225 and 600 kg^f/cm^2 respectively.

(vii) *Amenability for preservative and preservative-cum-fire retardant* : Results reported in Table 2 indicate that the species is easy to treat with water soluble preserving chemicals In 15 minutes treatment at 2 kg/cm^2 pressure, absorptions obtained are 19.80 kg/m^3 using 4.0 per cent CCA, which are more than the minimum required, i.e., 12 0 kg/m^3. In the fire-retardant treatment of plywood also results reported indicate that by using 6 per cent solution, dry salt absorptions of about 33.21 kg/m^3 were obtained which also meet the minimum requirements.

Further, glue shear strength values reported in Table 3 indicate that the chemicals used in the preservative or fire-retardant treatment of plywood at the required absorptions level do not have any appreciable effect on glue bond. Glue shear strength values (avg.) in dry and wet state for control, preservative and fire-retardant treated specimens are 187.5 kg and 163.3 kg, 170.9 kg and 179.9 kg, and 175.4 kg and 173.9 kg respectively. These values are higher than those required i.e., 135 kg (dry) and 100 kg (wet).

(viii) *Suitability for blockboards* : WWR (Warm water resistance at 70° ± 2°C for 3 hr) and BWP (Boiling water resistance for 72 hr) test conducted on U-F and P-F bonded boards did not show any delamination. Further in mycological tests too, no delamination in glue bond was observed. Thus, this species can be used for making blockboards (grade II U-F bonded for interior purposes and grade I P-F bonded for

exterior purposes), meeting the requirements of Indian Standard (IS : 1659–1969).

Conclusions

On the basis of test results reported, it can be concluded that the *Alnus nitida* (Alder) could be peeled into good quality veneers with ease. Further, the species is suitable for making plywood of various grades meeting the requirements of general purpose plywood (IS : 303-1975), preservative treated plywood (IS : 5539-1969), fire retardant plywood (IS : 5509-1980), plywood for concrete shuttering works (IS : 4990-1981) and for marine plywood (IS : 710-1976). It could also be used for making blockboards (IS : 1659-1969). Attractive colour and anatomical features in Alder suggest its utilisation for making decorative veneers and panels. The species, therefore, could be included in the list of species suitable for above purposes in various Indian Standard Specification.

SUMMARY

Suitability of *Alnus nitida* (Alder) was studied for making various grades of plywood and blockboards with commercial adhesives viz., U-F and P-F. Alder is suitable for making plywood for general purpose, preservative treated plywood, fire retardant treated plywood, plywood for concrete shuttering work and for blockboard. It is also easy to treat with water soluble preservatives and fire retardant chemicals, which do not affect the glue bond to any great extent. *Alnus nitida* therefore, could be included in the list of species recommended for the above purposes in the various Indian Standard Specifications.

भारतीय प्रकाष्ठों से स्तरकाष्ठ बनाना—एल्नस नीटिडा (एल्डर)

के०एस० शुक्ल, एल०एन० शुक्ल व रमेश चन्द्र

सारांश

व्यापारिक अभिलागियों अर्थात् यूरिया फार्मेल्डिहाइड और पैराफार्मेल्डिहाइड द्वारा विभिन्न ग्रेडों का स्तरकाष्ठ तथा खण्डफलक बनाने के लिए एल्नस नीटिडा (एल्डर) की उपयुक्तता का अध्ययन किया गया। एल्डर सामान्य प्रयोजनों का स्तरकाष्ठ (प्लाइवुड), परिरक्षी उपचारित स्तरकाष्ठ, अग्नि प्रतिरोधी उपचारित स्तरकाष्ठ, कंक्रीट का संवारक बनाने का स्तरकाष्ठ तथा खण्डफलक बनाने के लिये उपयुक्त है। इसका जल विलेय परिरक्षियों और अग्नि प्रनिरोधी रसायन पदार्थों द्वारा सरलता से उपचार किया जा सकता है जो इसकी अभिलागी पकड़ को अधिक प्रभावित नहीं करते। अतः एल्नस नीटिडा को उपर्युक्त प्रयोजनों के लिये विभिन्न भारतीय मानक विशिष्टियों में अभिस्तावित प्रकाष्ठ जातियों की सूची में जोड़ा जा सकता है।

References

George, Joseph (1977). Economics of production of synthetic resin adhesives, *IPIRI J.*, **7** (2), 48-65.

ISI (1975). Specification for plywood for general purposes, IS : 303, *ISI*, New Delhi.

ISI (1983). Specification for methods of test for plywood, IS : 1734 (Part I - XX), *ISI*, New Delhi.

ISI (1981). Specification for plywood for concrete shuttering work. IS : 4990, *I.S.I.*, New Delhi.

ISI (1930), Specification for fire retardant plywood, IS : 5509, *ISI*, New Delhi.

ISI (1982). Code of practice for preservation of timber, IS : 401, *ISI*, New Delhi.

ISI (1976). Specification for marine plywood, IS : 710, *ISI*, New Delhi.

ISI (1981). Specification for water soluble wood preservatives, IS : 10013, Part II, C.C.A., *ISI*, New Delhi.

ISI (1969). Specification for blockboards, IS : 1659, *ISI*, New Delhi.

Pearson, R.S. and H.P. Brown (1932). *Commercial Timber of India*, Govt. of India Press, Vol. 2, 972-974.

Shukla, K.S., M.S. Rajawat and L.N. Shukla (1985). Plywood from Indian Timbers : *Ulmus wallichiana*, Planch, *J. Timber Dev. Asso.*, Vol. XXXI, No. 4, October. pp 33-44

STUDIES ON SEASONAL ACTIVITY OF SOME AGRO-FORESTRY INSECT PESTS BY LIGHT TRAP

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Introduction

The use of light trap in studying the activity, abundance, sex ratio of flying adults in based on the assumption that changes in the trap catches are mainly on expression of variation in the actual population of the adults present in the environment (Person, 1976). Nocturnal insect species are positively phototropic and attracted towards artificial light in large numbers. The light trap serves as an important tool for sampling population of night flying adults effectively as well as to ascertain the peak period of insect activity, helpful in predicting the infestation level during various seasons. The review of literature shows the significant contribution made by Beeson, 1941; Mathur *et al.*, 1961; Otman, 1964; Sohi, 1964; Hartstock *et al.*, 1966; Falcon, 1967; Brown, 1968; Atwal *et al.*, 1969; Pruthi, 1969; Beckman, 1970; Richard and Davis, 1980; Vaishampayan, 1980; Chavan *et al.*, 1981; Verma and Vaishampayan, 1983; Vaishampayan and Bahadur, 1983. Application of light trapping techniques under forestry condition is found feasible, economic and prevents the use of toxic and hazardous chemicals, pesticides etc. in pest mangement without any adverse environmental effect on fauna and flora.

The present work deals with the studies on seasonal variation and population fluctuation, abundance, activity and insect pest situation of some major insect species (15 species) of agro-forestry importance, monitored in light trap for the two years period (July 1983 till June 1985) at Jabalpur. The observations recorded and results achieved are summarised and discussed.

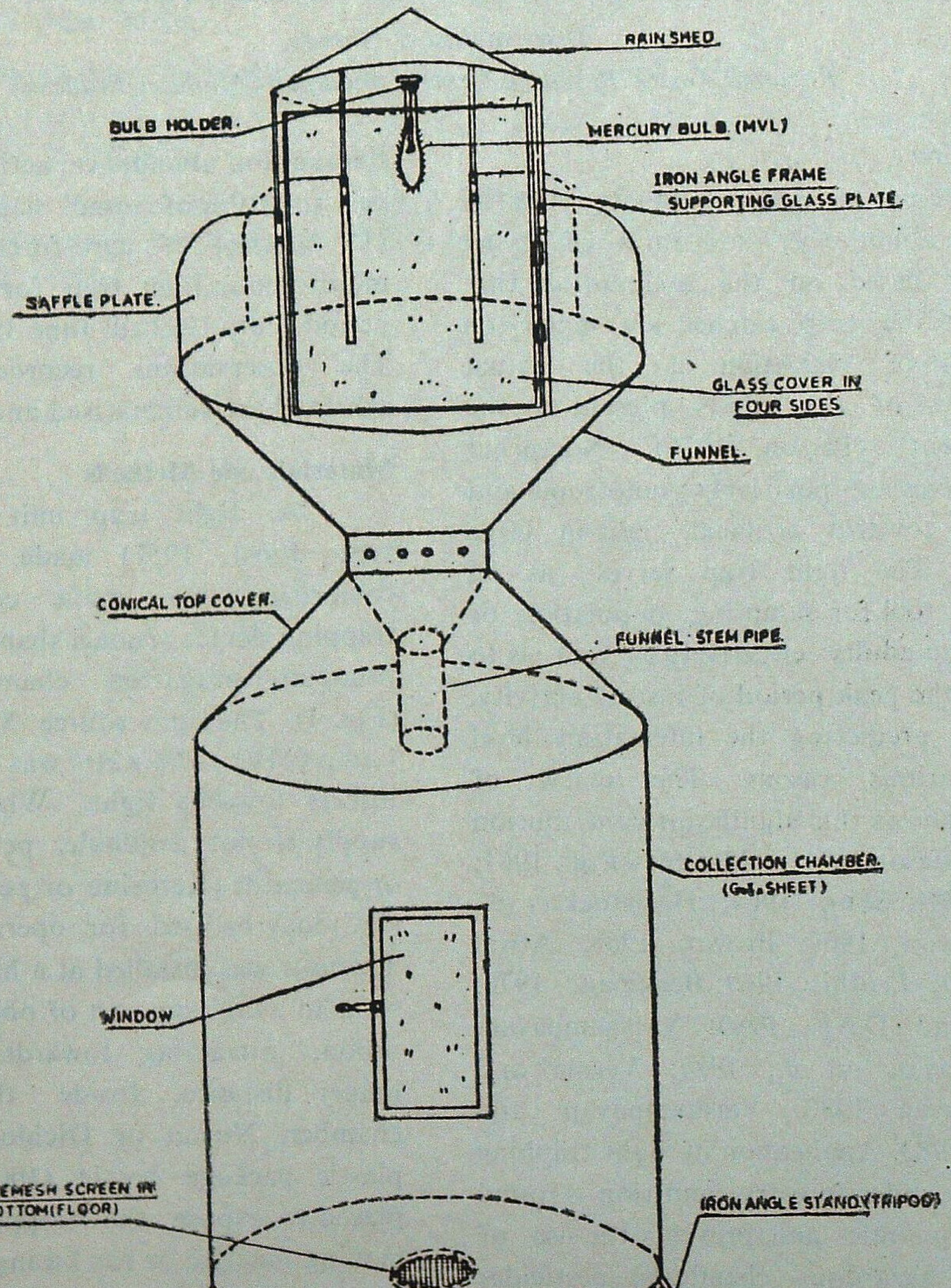
Materials and Methods

A light trap unit (Pennsylvanian type; Frost, 1957) made of G. I. sheet, comprising two main components i.e. trapping device (funnel shaped) and collection-cum-fumigation chamber, was used (Fig. 1). The light source Mercury Vapour Lamp (MVL) 160 watts was used, attracting insects towards light. Where the electric supply is not available, petromax, lantern or generator (Kerosine or petrol) or battery (DC) may be used for operating the unit. The unit was installed at a higher elevation so as to avoid any sort of obstacle in insect vision, attracting towards light from a longer distance. Inside the fumigation chamber, Nuvan or Dichloros keeping in plastic package bottle (100 ml cap.) was placed to expose the trapped insects for making inactive or for kil.ing purpose. The unit was operated every night from dusk to dawn, next morning, the sampling of the day to day catches was done. The collection of each day samples was considered as a replication. During sampling, sorting of

insects, species-wise counting, identification, preservation and indexing was done and data recorded. The meteorological data mainly temperature, relative humidity and rainfall of the study area was maintained.

The methodology and procedure adopted was found effective and efficient without any operational difficulty in working because the equipment is portable, folding type and adjustable and can be conveniently

Fig 1



Design of light trap unit : (i) trapping device (funnel type) (ii) Collection-cum-Fumigation Chamber, showing other parts.

used in forest areas. The data recorded were analysed and summarised.

Observations and Discussions

During the course of present studies, observations were recorded on seasonal activity, abudance of fifteen (15) insect pest species of agro-forestry importance that cause damage to forest nurseries and plantations. The insect larvae defoliate, suck the sap, feed on inflorescence, pods etc. The insect species among Lepidopterous caterpillars i.e. *Agrotis ipsilon* Rott. (Greasy cutworm, surface caterpillars) (Noctuidae), *Argina cribraria* Clerch (Arctidae); *Eutectona machaeralis* Wlk, teak skeletoniser (Pyralidae), *Euproctis lunata* Wlk (Lymantridae), *Heliothes armegera* F. (Noctuidae), *Hyblaea puera* Cram. (Hyblaeidae) teak defoliator; *Perine nuda* F. (Lymantridae); *Plusia orichalsia* F. (Noctuidae), *Prodenia litura* (Noctuidae), *Trigonodus hippasia* Cram. (Noctuidae), *Utethesia pulchella* L. (Arctidae). In sap sucking insects, the Hemipterous bug *Dysdercus cingulatus* F. (Pyrrhocoriedae) red cotton bug and orthopterous insect, cricket species *Gryllotalpa africana* (Gryllotalpidae) and Gryllus sps. (Gryllidae). In Coleopterous insects, the wood borer *Xylotrechus smei* L & G (Cerambycidae) was studied and insect activity, population fluctuation recorded throughout the year for two years period.

It is evident from Table 1 and 2 that highest population of *Agrotis* sp. was recorded during April, while it was lowest during the period June to December. In peak period, the insect population was recorded 39.95 and 24.09 per cent in the respective years (1983–84 and 1984–85) due to favourable ecological conditions and availability of sufficient food supply. The population of *Argina* sp. was found at high level in July month, later on it was found declined and negligible in December. Again, population built up started from next June to reaches to its peak during next July as per two years data recorded (Table 1 and 2). In red cotton bug *Dysdercus* sps., the maximum number of adult bugs were trapped in June and then population level decreased. In October, the pest was found abundant again reaches to its peak. The infestation level increased in field due to high intensity of attack during active period at peak. The insect was found at slowest activity in colder month, showed declined in population from November to January till April month. The teak skeletoniser *Eutectona machaeralis* and defoliator *Hyblaea puera* population monitored throughout the year. The teak skeletoniser *Eutectona machaeralis* was found very active during August to October, showing highest population and infestation in September while the pest activity was at low in the rest of the part of the year. During this period, climatological conditions were most favourable alongwith sufficient quantity of fresh teak foliage as food was available. Therefore, the insect development was rapid and found in abundance. The teak defoliator *Hyblaea puera* population was found at its peak in July during the active period from June to August. The population built up started from the end of June. During the extreme cold and hot the pest population was found negligible. The population and abundance of the insect is correlated with the onset of monsoon, only starts building up after the rains due to hatching of the

Table

Distribution, relative abundance of adult population, percentage of various insect pest species trapped

Name of the insect species	Total no. of insect species trapped.	No. of insect species			
		July '83	Aug.	Sept.	Oct.
Agrotis ipsilon Rott.	488	8 (1.78)	0 (0.0)	41 (9.15)	0 (0.0)
Argina cribraria Clerch	186	88 (47.31)	47 (25.25)	14 (7.52)	11 (5.91)
Dysdercus cingulatus F.	2335	283 (12.12)	185 (7.92)	68 (2.91)	348 (14.90)
Eutectona machaeralis Wlk.	1503	270 (16.96)	183 (12.17)	532 (35.39)	158 (10.51)
Euproctis lunata Wlk.	1106	0 (0.0)	3 (0.27)	162 (14.68)	922 (83.36)
Gryllotalpa africana	647	214 (33.07)	116 (17.92)	48 (7.42)	19 (2.93)
Gryllus sp.	11636	2154 (18.51)	524 (4.50)	318 (2.73)	414 (3.55)
Heliothis armegera F.	3432	10 (0.29)	3 (0.08)	0 (0.0)	2 (0.06)
Hyblaea puera Cramer	2505	1758 (70.18)	611 (24.39)	94 (3.75)	0 (0.0)
Perina nuda Fab.	169	0 (0.0)	0 (0.0)	0 (0.0)	51 (30.17
Plusia orichalsia Fab.	415	28 (6.74)	14 (3.37)	39 (9.39)	0 (0.0)
Prodenia litura F.	403	30 (7.44)	24 (5.95)	41 (10.17)	44 (10.91)
Trigonodus hippasia Cram.	211	16 (7.58)	2 (0.95)	53 (25.11)	98 (46.44)
Utetheisa pulchella Lin.	579	30 (5.18)	24 (4.14)	42 (7.25)	0 (0.0)
Xylotrechus smei L & G.	440	80 (18.18)	62 (14.09)	37 (8.41)	42 (9.54)

Figures shown in parenthesis ( ) represent the population in per cent.

1

on light trap catches during the period July 1983—June 1984 based on daily record of each month.

collected & percentage							
Nov.	Dec.	Jan. '84	Feb.	March	April	May	June '84
0 (0.0)	9 (2.0)	64 (14.28)	45 (10.04)	85 (18.97)	179 (39.95)	13 (2.90)	4 (0.89)
8 (4.30)	0 (0.0)	9 (4.83)	7 (3.76)	1 (0.53)	1 (0.53)	0 (0.0)	0 (0.0)
0 (0.0)	0 (0.0)	0 (0.0)	2 (0.085)	2 (0.085)	8 (0.34)	70 (2.99)	1369 (58.62)
6 (0.39)	1 (0.06)	0 (0.0)	0 (0.0)	0 (0.0)	23 (1.53)	41 (2.73)	289 (19.23)
19 (1.71)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
21 (3.24)	29 (4.48)	44 (6.80)	7 (1.08)	48 (7.42)	16 (2.47)	17 (2.63)	68 (10.51)
0 (0.0)	2 (0.017)	27 (0.23)	68 (0.58)	191 (1.64)	584 (5.02)	2687 (23.09)	4667 (40.11)
2 (0.06)	5 (0.14)	65 (1.89)	51 (1.48)	117 (3.40)	1676 (48.83)	1464 (42.65)	37 (1.08)
0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	42 (1.67)
3 (1.77)	17 (10.06)	33 (19.52)	35 (20.71)	27 (15.97)	0 (0.0)	3 (1.77)	0 (0.0)
0 (0.0)	0 (0.0)	40 (9.64)	27 (6.50)	89 (21.44)	138 (33.25)	37 (38.91)	3 (0.72)
52 (12.90)	19 (4.71)	11 (2.73)	42 (10.42)	36 (8.93)	70 (17.37)	27 (6.69)	7 (1.73)
15 (7.11)	2 (0.95)	5 (2.36)	2 (0.95)	9 (4.26)	9 (4.26)	0 (0.0)	0 (0.0)
0 (0.0)	0 (0.0)	5 (0.86)	0 (0.0)	13 (2.25)	299 (51.64)	142 (24.56)	24 (4.14)
0 (0.0)	0 (0.0)	0 (0.0)	4 (0.90)	6 (1.36)	11 (2.5)	26 (5.90)	172 (39.09)

Table

Showing distribution and relative abundance of various insect pest collected by

Name of the insect species	Total no. of insect species trapped.	No. of insect			
		July '84	Aug.	Sept.	Oct.
Agrotis ipsilon Rott.	332	0 (0.0)	0 (0.0)	26 (7.83)	6 (1.80)
Argina cribraria Clerch	143	68 (47.55)	20 (13.98)	18 (12.58)	16 (11.18)
Dysdercus cingulatus F.	1021	76 (7.44)	31 (3.03)	33 (3.23)	156 (15.27)
Eutectona machaeralis Wlk.	1569	372 (23.70)	211 (13.44)	700 (44.61)	7 (0.44)
Euproctis lunata Wlk.	1153	0 (0.0)	0 (0.0)	20 (1.73)	1104 (95.75)
Gryllotalpa africana	256	79 (30.85)	23 (8.98)	21 (8.20)	55 (21.48)
Gryllus sp.	12652	8048 (63.61)	89 (0.70)	295 (2.33)	786 (6.21)
Heliothis armegera F.	895	2 (0.22)	0 (0.0)	0 (0.0)	0 (0.0)
Hyblaea puera Cramer	3168	2475 (78.12)	505 (15.94)	32 (1.01)	0 (0.0)
Perina nuda Fab.	161	0 (0.0)	0 (0.0)	0 (0.0)	64 (39.75)
Plusia orichalsia Fab.	381	8 (2.09)	9 (2.36)	33 (8.66)	16 (4.19)
Prodenia litura F.	233	29 (12.44)	2 (0.85)	54 (23.17)	63 (27.03)
Trigonodus hippasia Cram.	289	11 (3.80)	5 (1.73)	32 (11.07)	143 (49.48)
Utetheisa pulchella Lin.	439	24 (5.46)	16 (3.64)	32 (7.28)	17 (3.87)
Xylotrechus smei L & G.	284	95 (33.45)	48 (16.90)	4 (1.40)	39 (13.73)

Figures shown in parenthesis ( ) represent the population in per cent.

2

light trap catches during the period July 1984 — June 1985

species collected & percentage

Nov.	Dec.	Jan. '85	Feb.	March	April	May	June' 85
2 (0.60)	38 (11.44)	64 (19.27)	60 (18.07)	47 (14.15)	80 (24.09)	8 (2.40)	1 (0.30)
2 (1.39)	0 (0.0)	13 (9.09)	2 (1.39)	1 (0.69)	0 (0.0)	3 (2.09)	0 (0.0)
2 (0.19)	0 (0.0)	2 (0.19)	27 (2.64)	34 (3.33)	15 (1.46)	118 (11.55)	527 (51.61)
1 (0.06)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0 0)	12 (0.76)	69 (4.39)	197 (12.55)
4 (0.34)	0 (0.0)	0 (0.0)	0 (0.0)	25 (2.16)	0 (0.0)	0 (0.0)	0 (0.0)
2 (0.78)	7 (2.73)	7 (2.73)	4 (1.56)	9 (3.51)	5 (1.95)	10 (3.90)	34 (13.28)
33 (0.26)	17 (0.13)	24 (0.18)	93 (0.73)	433 (3.42)	236 (1.86)	1381 (10.91)	1217 (9.61)
1 (0.11)	36 (4.02)	102 (11.39)	31 (3.46)	202 (22.56)	235 (26.25)	256 (28.60)	30 (14.35)
0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	156 (4.92)
17 (10.55)	12 (7.45)	20 (12.42)	25 (15.52)	10 (6.21)	3 (1.86)	5 (3.10)	5 (3.10)
1 (0.26)	9 (2.36)	46 (12.07)	47 (12.33)	48 (12.59)	128 (33.59)	21 (5.51)	15 (3.93)
12 (5.15)	3 (1.28)	0 (0.0)	3 (0.82)	2 (0.85)	47 (20.27)	17 (7.29)	1 (0 42)
12 (4.15)	4 (1.38)	13 (4.49)	25 (8.65)	33 (11.41)	10 (3.46)	1 (0.34)	0 (0.0)
0 (0.0)	1 (0.22)	8 (1.82)	10 (2.27)	102 (23.23)	90 (20.50)	32 (7.28)	107 (24.37)
3 (1.05)	0 (0.0)	0 (0.0)	0 (0.0)	7 (2.46)	5 (1.76)	20 (7.04)	63 (22.18)

Table 3

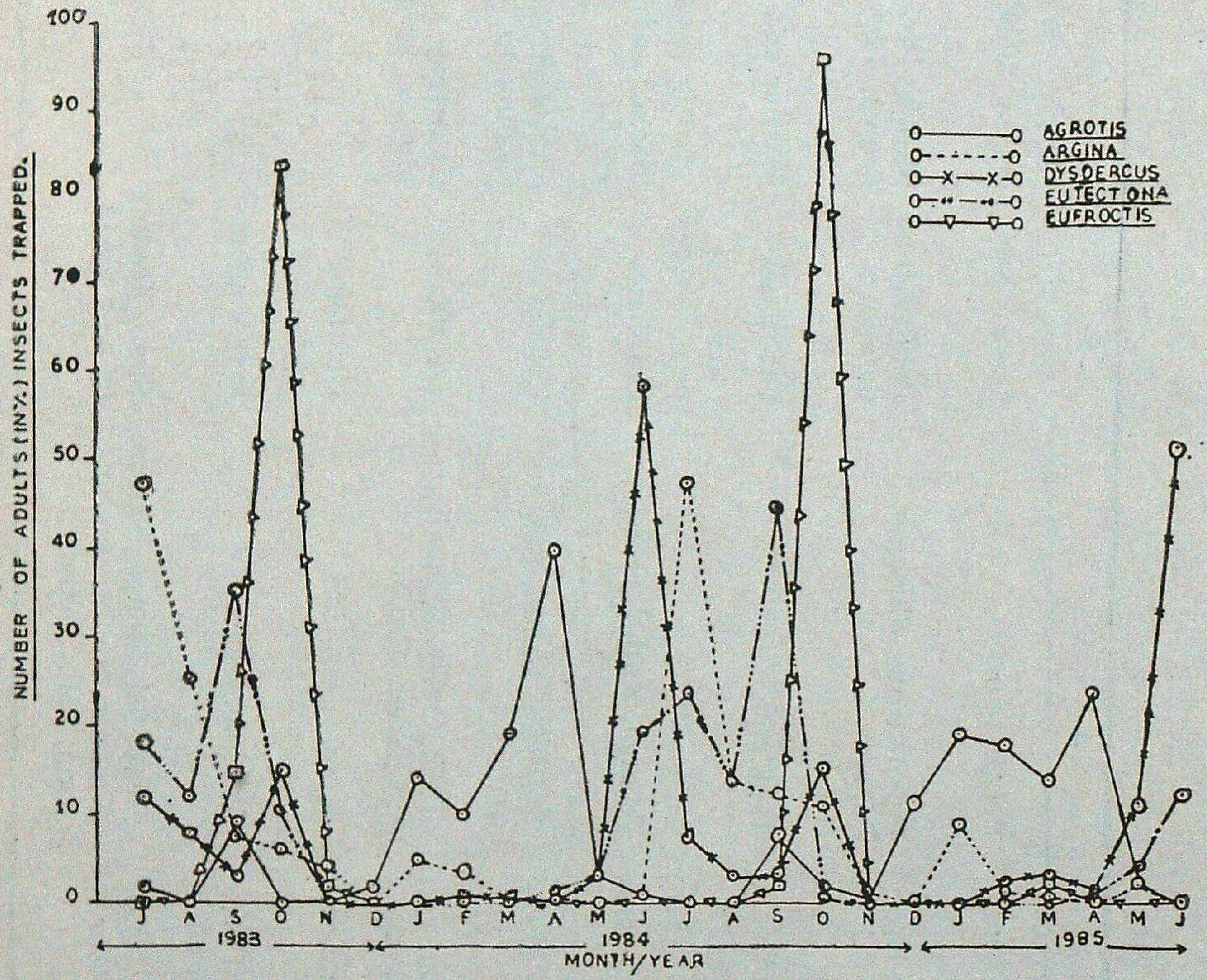
Period of activity, infestation level, host tree species attacked, damage etc.
(July 1983–June 1985)

Insect pest species	Period of activity		Host plant species (damaged)	Nature of damage	Author
	High	Low			
1	2	3	4	5	6
Agrotis ipsilon Rott. Surface caterpillar (Lep : Noctuidae)	April	June-Dec.	Teak, Pines, Babool, Mango, Semul, Anjun ,Bahera, Palas, Shahtood, Mulbery.	Polyphagous Defoliates	Verma and Vaishampayan(1983)
Argina cribraria Clerch (Lep : Arctidae)	July	Dec., Jan., June.	Crotolaria	Inflorescence feeder	Beeson, 1941
Dysdercus cingulatus Fab. red cotton bug (Hemiptera : Pyrrhocorriedae)	Sept.-Oct.	Dec., Jan-May	Cotton, Semul, Solanum sp.	Sap sucker	Beeson, 1941; Sohi, 1964
Eutectona machaeralis Wlk. Teak skeletoniser (Lep : Pyralidae)	Sept.-Oct.	Dec. Jan-May	Teak etc.	Defoliates	Beeson, 1941
Euproctis lunata Wlk. (Lep : Lymantridae)	Oct.	Nov-Dec. Jan-Aug.	Mango, Saja, Ber, Shahtoot	Defoliates	Mathur and Singh, 1961
Gryllotalpa africana Cricket (Orth : Gryllidae)	June-July	Nov-Dec.	Polyphagous, Bischofia	Omnivorous Burrowing	Pruthi, 1969; Richard and Davis, 1980; Chavan and Rao, 1981.

(*Contd...*)

1	2	3	4	5	6
Gryllus sp. (Orth : Gryllidae)	June-July	Nov-Dec.	Polyphagous	Omnivorous	Pruthi, 1969
Heliothis armegera F. (Lep : Noctuidae)	March-April-May	July-Dec.	Polyphagous, Shisham, Poplar	Polyphagous defoliates	Beeson, 1941; Brown, 1968
Hyblaea puera Cram. Teak defoliator (Lep : Lymantridae)	July	Oct-Dec. Jan-May	Teak etc.	Defoliates	Mathur and Singh, 1954
Perina nuda Fab. (Lep : Lymantridae)	Oct.	April-Sept.	Mango, Kathal, Gular	Defoliates	Mathur and Singh, 1961
Plusia orichalsia Fab. (Lep : Noctuidae)	April	June-Dec.	Shisham, Jamun, Ber, Palas	Defoliates	Chatterjee and Mishra, 1974
Prodenia litura F. (Lep : Noctuidae)	April-Oct.	Dec. Jan-Aug.	Teak, Gular, Sesbania, Casuarina, Castor	Defoliate	Chatterjee and Mishra, 1974
Trigonodus hippasid Cram. (Lep : Noctuidae)	Oct.	May-Aug.	Kullu	Defoliate	
Utetheisa pulchella L. (Lep : Arctidae)	March June	Oct-Dec. Jan-Feb.	Polyphagous	Polyphagous	
Xylotrechus smei L & G (Col : Cerambyicdae)	June, July	Nov.-Dec. Jan-April	Teak, Sal, Mango, Shisha, Khamer, Haldu, Semiul, toon, Palas, Gular	Borer, feeding on soft wood	

Fig. 2



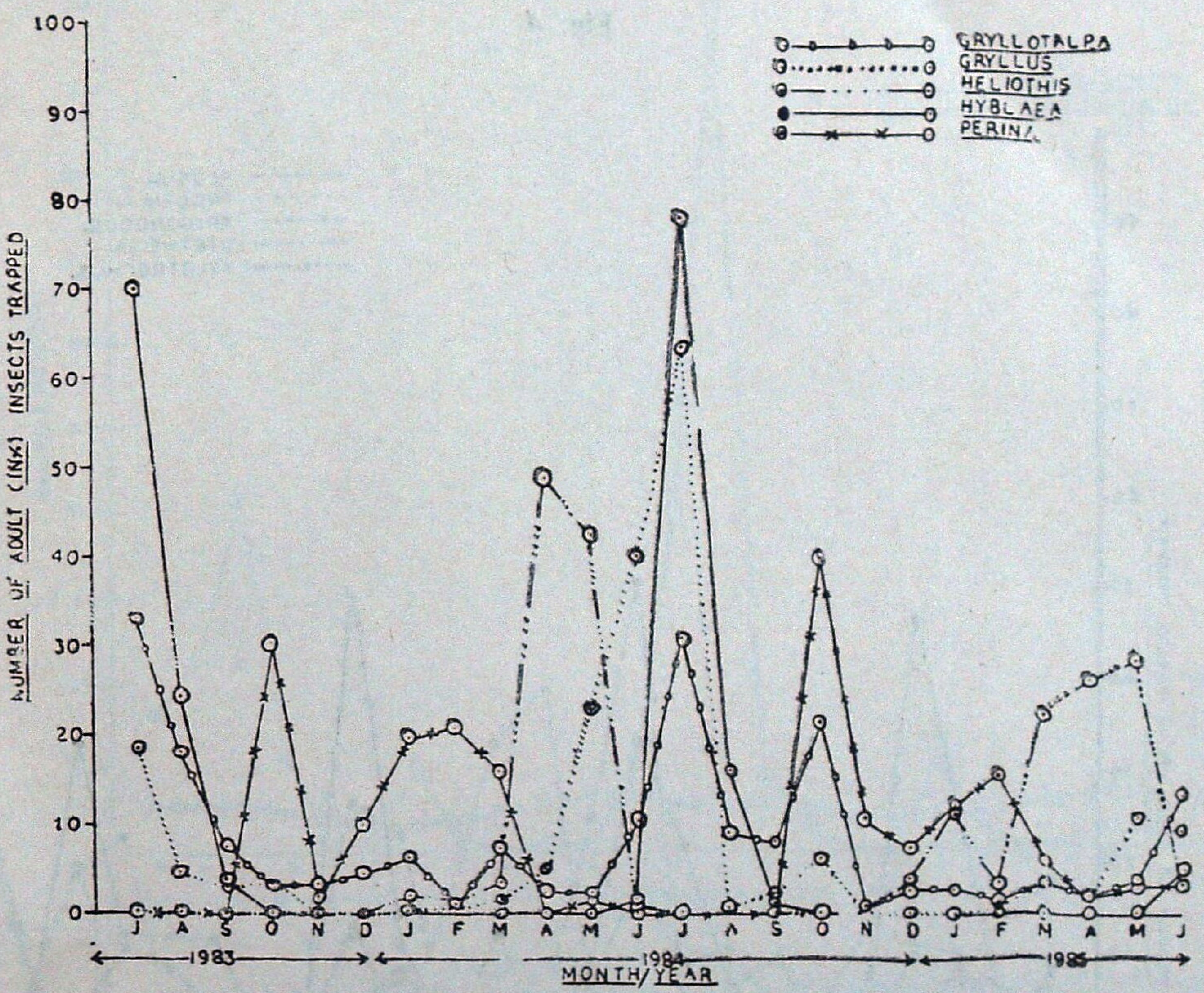
Seasonal abundance, variation in population level in the insect species *Agrotis ipsilon*, *Argina cribraria*, *Dysdercus cingulatus*, *Eutectona macheralis*, *Euproctis lunata* in field condition during July 1983 to June 1985, showing population in per cent calculated period-wise on yearly basis.

eggs. The same period is the growth period of teak sprouting fresh foliage which are found defoliated due to insect feeding often in epidemic or outbreak. During peak period, the population of *H. puera* recorded 70.18 and 78.12 per cent while in *E. machaeralis* was 35.39 and 44.61 per cent in respective years (1983-84 and 1984-85 in July) as shown in table 1 and 2.

The adult *Euproctis* sp. was trapped in maximum number during October, showing highest activity and population during September and October (Table 1 and 2) while it was slow in the rest of the month. During peak period, the population was recorded 83.36 and 97.75 per cent in July as per two years data (1983-84 and 1984-85) recorded.

The cricket species *Gryllotalpa* sp. and *Gryllus* sp. were abundantly found during June and July month in rains. The population of *Gryllotalpa* was recorded 33.07 and 30.85 per cent while in *Gryllus* sps. it was 40.11 and 63.61 per cent as per two years

Fig. 3



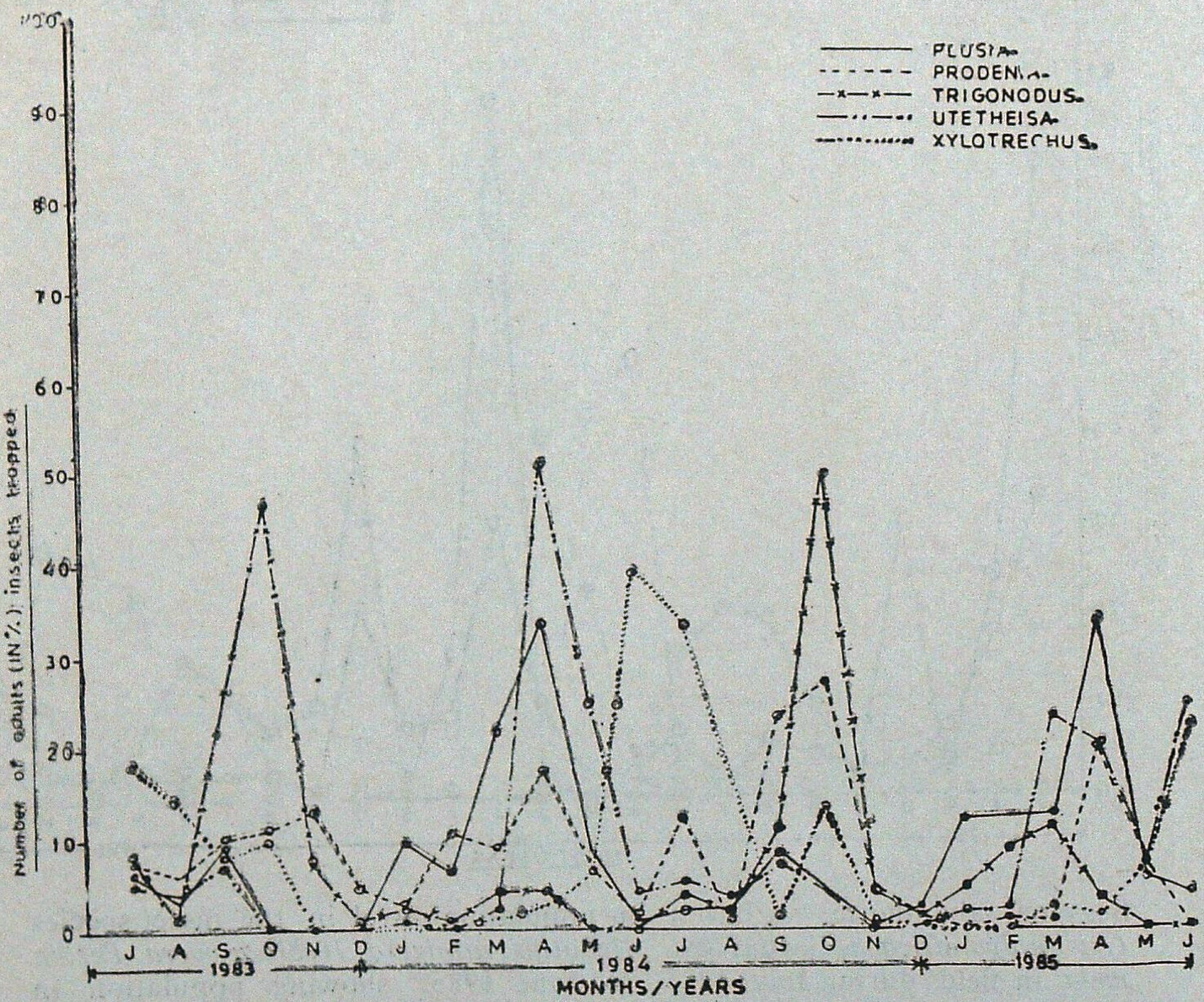
Seasonal abundance, variation in population level in the insect species *Gryllotalpa africana*, *Gryllus* sps., *Heliothis armigera*, *Hyblaea puera*, *Perina nuda* in field during July 1983 to June 1985, showing population in per cent calcualated period-wise on yearly basis.

observation starting from July 1983 to June 1985.

The *Heliothes* sps. population was found at high during April and May and fluctuation noticed till August. Later on the population declined and found negligible in December. (Table 1 and 2). In *Perina nuda*, increased activity recorded in October showing the peak population level at 30.17 and 39.75 per cent during 1983-84 and 1984-85 in October month. The decline in population noticed from April ending to September. The highest number of adults *Prodenia* sp. were trapped during October and November month, showing population 10.91 and 12.90 per cent in 1983 while 17.37 per cent in April 1984. It was found increased during 1984 at 27.03 per cent (Oct. '84). In *Plusia* sps., the insect ac:ivity was at its peak during April, showing population 33.25 and 33.59 per cent in respective years.

It is evident from the Table 1 and 2 that highest population of *Trigonodus* sp. was

Fig. 4

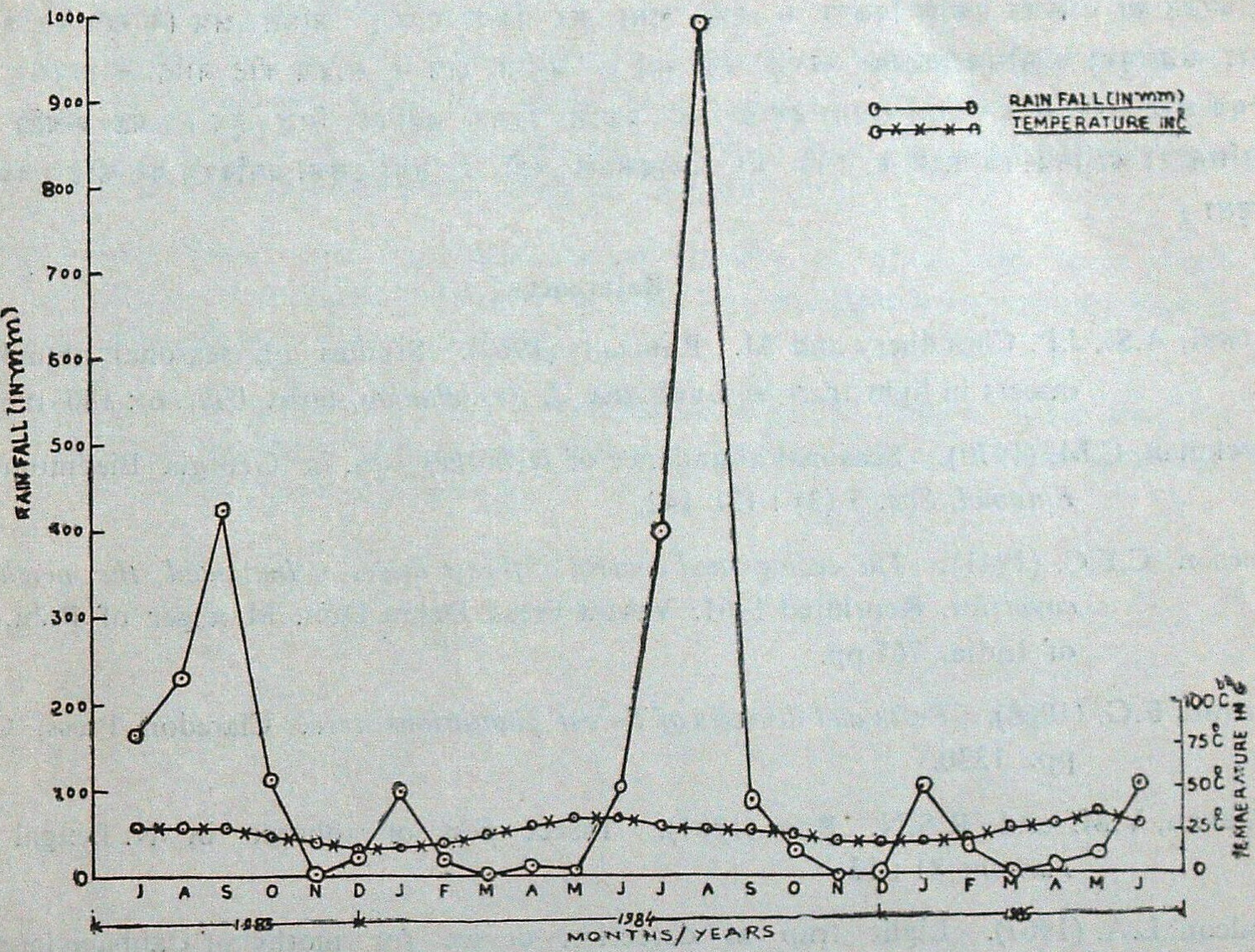


Seasonal abundance, variation in population level in the insect species *Plusia orichalsia*, *Prodenia litura*, *Trigonodus hippasia*, *Utetheisa pulchella*, *Xylotrechus smei* in field during July 1983 to June 1985, showing population in per cent calculated period-wise on yearly basis.

observed in October, showed 46.44 and 49.48 per cent population while in *Utetheisa* sps. recorded during April (51.64 per cent) and June (24.37 per cent) during the period of study. The optimal condition for rapid development was available at temperature 23.3° to 24.5°C in field for *Trigonodus* and 24.3° to 29.1°C for *Utetheisa* sps.

The cerambycid beetle *Xylotrechus* sps., showed highest activity and infestation level during June and July. In June, the population was 39.09 per cent (1983-84) and 33.45 per cent (1984-85) as per two year data recorded. During cold month from November onward till April, the activity was slowed. In extreme cold, the insect population was found completely negligible as apparent from Table 1 and 2.

Fig. 5



Ombrothermic Diagram

Climatological data of field temperature (°C) and Rainfall (mm) of different months during the period July 1983 to June 1985 of the study area.

SUMMARY

Seasonal activity and abundance of insect pest species (15 insect species) i.e. defoliators, borers and sap suckers of agro-forestry importance were studied for two years during 1983 to 1985. Variation in adult population during different months, peak period of activity, infestation, fluctuation in population level on the basis of light trap catches were recorded. The meteorological data of the study area (KVAK, Jabalpur) was maintained. Light trap device was found helpful in predicting the active insect species in study area, the infestation time and level. The technique is found effective in forest pest management having no adverse effect on environment.

प्रकाश पिंजरों द्वारा कतिपय कृषि-वानिकी नाशिकीटों की मौसमी सक्रियता का अध्ययन

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सारांश

1983 से 1985 दो वर्षों तक कृषि-वानिकी के लिये महत्व के नाशिकीटों (15 कीट जातियां) अर्थात् निष्पत्रकों, छिद्रकों और रसचूषकों की मौसमी सक्रियता और उनकी प्रचुरता का अध्ययन किया गया।

भिन्न-भिन्न महीनों में वयस्क कीड़ों की संख्या में विभिन्नता, सक्रियता की शिखर अवधि, कीटाक्रमण, कीट संख्या में घटबढ़ का आलेखन प्रकाश पिंजरों में उन्हें फंसा कर किया गया। अधित क्षेत्र (केन्द्रिय वन अनुसन्धान केन्द्र, जबलपुर) के मौसम विज्ञान आंकड़े रखे गए। अधीत क्षेत्र में सक्रिय कीट जाति, कीटाक्रमण होने का समय और उसके स्तर की पूर्व सूचना देने के लिये प्रकाश रिंजरे सहायक सिद्ध हुये। यह प्रविधि वनों में नाशिकीटों का नियन्त्रण करने के लिये भी प्रभावकारी रही है तथा इसका पर्यावरण पर कोई कुप्रभाव नहीं पड़ता।

References

Atwal, A.S., J.P. Choudhery and M. Ramzan (1969). Studies on seasonal abundance of insects in light trap at Ludhiana. *J. Res. Punjab Agric. Univ.* **6** : 186-196.

Beckman, C.M. (1970). Seasonal abundance of *Heliothes* sps. in Georgia Piedmont *J. Ga. Entomol. Soc.* **5** (3) : 131–142.

Beeson, C.F.C. (1941). *The ecology and control of forest insect of India and the neighbouring countries.* Reprinted 1961. Vasant Press, Dehra Dun. Manager of Publ. Govt. of India. 767 pp.

Brown, F.G. (1968). *Pests and diseases of Forest plantations tree.* Claredon Press, Oxford. pp. 1330.

Chavan, V.M. and R.S.N. Rao (1981). Insect pest of tobacco in N. Bengal *Indian Farming* 81 : 13

Falcon, L.A. (1967). Light trap as detection device for moths of Cabbage looper and ballworm *Calif. Agric.* **21** (7).

Frost, S.W. (1957). The Pennsylvanian Insect light trap. *J. Econ. Ent.* **50** : 287–297.

Hartstock, J.G., H.D. Deay and J.R. Baret Jr. (1966). Practical application of insect attraction in the use of light trap. *Bull. Ent. Soc. Amer.* **12** (4) : 375-377.

Mathur, R.N. and B. Singh (1961). A list of insect pests of forest plants in India and the adjacent countries (Part 10)–list of insect pest of plant genera 'T to Z' *Indian For. Bull.* No. **171** (9) : 116 pp.

Otman, E.R. (1964). Orchard insect surveys with black light traps. *J. Econ. Entomol.* **57** (1) : 6–8.

Person, B. (1976). Influence of weather and nocturnal illumination on the activity and abundance of population of noctuidae (Lepidoptera) in South Coastal Queensland. *Bull. Entomol. Res.* **66** : 33–63.

Pruthi, H.S. (1969). *Text book on Agricultural Entomology.* I.C.A.R., New Delhi.

Richard, O.W. and R.G. Davis (1980). *A general Text book of Entomology* (Rev. Ed.) Asia Publ., New Delhi.

Sohi, G.S. (1964). Pest of Cotton. *Entomology in India* (1938–63) pp. 111–148. Jubl. Ed. *Ent. Soc. India*, New Delhi.

Vaishampayan, S.M. and A. Bahadur (1983). Seasonal activity of adults of teak defoliator *Hyblaea puera* and teak skeletoniser *Pyrausta machaeralis* (Pyralidae : Lepidoptera) monitored by light trap catches. Seminar held on *Insect interrelations in Forest and Agro-ecosystems* at Dehra Dun (Oct. '83).

Vaishampayan, S.M. (1980). Seasonal abundance and activity of gram pod borer moth *Helicoverpa* (*Heliothis*) *armigera* on light trap equipped with mercury vapour lamp at Jabalpur. *Ind. J. Ecol.* 7 (1) : 147.

Verma, R. and S.M. Vaishampayan (1983). Seasonal activity of major insect pests on light trap equipped with mercury vapour lamp at Jabalpur. *Proc. Symp. Ins. Ecol. and Resources.* 173–180 pp.

STUDIES ON PHYSICAL AND MECHANICAL PROPERTIES OF *STERCULIA URENS*

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Introduction

Sterculia urens (trade name Karar) is a medium-sized tree with greenish-grey bark and reddish brown heartwood. It generally grows in the forests of Central India and Western ghats (Chowdhury *et al.*, 1958 and Nazma *et al.*, 1981). Athough it is reported to be used for doors of huts, dug-out canoes, boat planking, guitars, carved toys, inferior packing cases and boxes, picture and slate frames; its strength properties have not been systematically evaluated and reported so far (Chowdhury *et al.*, 1958 and Pearson & Brown, 1932). In the present paper the physical and mechanical properties of *Sterculia urens* procured from Agumbe Forest Range of Shimoga Division of Karnataka State Forest have been reported and discussed.

Material and Methods

Five logs of *Sterculia urens*, drawn from 5 trees (age 40 years) were obtained from Agumbe Forest Range of Shimoga Division. The length and girth of logs were on an average 3.50 and 1.20 metres respectively. Layout and conversions of testing material both in green and air-dry conditions was carried out as per Indian Standards Specification IS : 2455-1974. Tests were carried out as per the Indian Standard IS : 1708-1969 except for tests in static bending and compression parallel to grain, specimens of smaller cross section (2.5 × 2.5 cms) were used due to limited capacity of the testing machine (Mohr & Federhaff A.G. Universal Testing Machine of 10 tonnes capacity).

Results

The average strength values in respect of various properties of *Sterculia urens* in green condition along with their maximum and minimum values, standard deviation, coefficient of variation and the average strength values of material in air-dry condition adjusted to 12% m.c. are reported in Table 1. The nail and screw holding properties were tested under the following two conditions :

(i) Driven in green condition and withdrawn at once.

(ii) Driven in air-dry condition and withdrawn at once.

The expected strength values of the species from sp. gravity-strength relationship (Sekhar & Rawat, 1959) have also been calculated in both green and air-dry conditions and are mentioned in Table 1. The improvement factors, i.e., the percentage increase in the values of various properties

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from green to air-dry condition have been calculated and given in the same Table. The average strength values in green and air-dry condition of *Tectona grandis* (Sekhar and Rawat, 1966) from Malabar, Nilambur and Coimbatore which normally considered as 'Standard' for comparison for other Indian timbers are given in the Table 1.

In Table 2, the safe working stresses which were calculated by the usual method (Sekhar and Rajput, 1972) for inside, outside and wet locations are given along with the corresponding values of "Standard teak" for purpose of comparison.

As usual the comparative suitability indices for various end uses were calculated as percentage of "Standard treak" using the standard formulae (Sekhar & Gulati, 1972) and the results are given in Table 3.

Discussion

It will be seen from Table 1 that most of the strength values of *Sterculia urens* have shown moderate to considerable improvement (15% to 87%) from green to air-dry condition; except in the case of nail holding and screw holding power in which the improvement has negative values.

On comparing the observed values with expected values in green condition it is noted that the observed values are on an average less by 20.5% than the expected values in most of the properties, while a higher observed value was noted in the case of MOE in static bending. The observed values agree with the expected values in case of F.S. at L.P., MOR in static bending, compression parallel to grain and end hardness.

A similar comparison for strength values of air-dry material showed that the observed values are greater on an average by 17.5% in MOE and compression parallel to grain. Observed tension perpendicular to grain is less by 27% than the expected value. The strength values are almost equal in F.S. at L.P., MOR in static bending, compression perpendicular to grain, hardness and shear.

Further, by comparing the experimentally determined green and air-dry values of *Sterculia urens* with teak it is observed that the strength values of *Sterculia urens* which is about 34% denser are much higher than those of teak in both green and air-dry conditions except in tension perp. to grain in which they are 55% less than teak in green condition and 37% less in air-dry condition and in compression perp. to grain in green condition in which they are about 10% less than teak. The strength values are almost equal to those of teak in F.S. at L.P. in green and air-dry conditions and in MOR compression parallel to grain, shear and end screw holding power in the green condition.

On comparing the safe working stresses of *Sterculia urens* with the corresponding values of teak given in Table 2, it is seen that extreme fibre stress is higher than teak by 6% on an average for all location, whereas shear (horizontal as well as along the grain) and maximum compressive stress parallel to grain are almost equal to those of teak. Safe working stress in compression perp. to grain is however 8% less than that of teak.

According to usual classification of timber (Sekhar & Gulati, 1972), Table 3 indicates that *Sterculia urens* can be classified as heavy to very heavy, very strong, moderately tough, rather poor in retention of

Table 1

Data on Physical and Mechanical Properties of Sterculia urens

Properties	Green						Air-dry		*Tectona grandis* (Std. teak) (Malabar, Nilambur & Coimbatore)		%Improvement factor
	Average	Max.	Min.	S.D.	CV%	Expected	Average	Expected	Green Average	Air-dry Average	
1	2	3	4	5	6	7	8	9	10	11	12
Physical :											
Sp. gravity (based on oven dry wt. and volume at test)	0.759	0.859	0.613	0.03	5.05	—	0.811	—	0.596	0.604	—
% Moisture content	55	89	40	7.7	14.07	—	12	—	76.6	12	—
Weight (kg/m³)	1176	—	—	—	—	—	908	—	1056	672	—
Shrinkage % green to oven dry :											
Radial	6.7	8.01	4.18	1.39	20.9	—	—	—	2.3	—	—
Tangential	9.4	10.02	8.75	0.47	5.0	—	—	—	4.8	—	—
Volumetric	12.8	15.73	9.29	2.27	17.6	—	—	—	6.9	—	—
Mechanical Static Bending :											
Fibre Stress at elastic limit (kg/cm²)	523	672	390	72.5	13.8	518	656	701	509	651	25.4
Modulus of Rupture (kg/cm²)	891	1107	617	125.7	14.1	875	1224	1212	841	959	37.4
Modulus of Elasticity (1000 kg/cm²)	145	240	102	32.9	22.7	125.9	184	157.9	109.7	119.6	26.9
Compression parallel to grain :											
Maximum crushing stress (kg/cm²)	422	588	274	67.0	15.9	440	793	669	415	532	87.9

(*Contd...*)

1	2	3	4	5	6	7	8	9	10	11	12
Compression perpendicular to grain :											
Compressive stress at E.L. (kg/cm²)	78	119	38	23.7	30.4	109	144	139	86	101	84.6
Hardness (load to embed 1.128 cm dia steel ball to half its diameter) :											
Radial (kg)	708	885	527	82	11.6	793	956	1042	557	502	35.0
Tangential (kg)	688	850	565	78	11.3	747	940	1002	551	524	36.6
End (kg)	771	915	595	81.4	10.5	760	1071	1033	486	488	38.8
Shear parallel to grain :											
Radial (kg/cm²)	88.2	148	46	24.7	28	102.5	126.3	131.1	89.5	96.6	43.2
Tangential (kg/cm²)	100.7	149	31	26.5	26	114.7	133.1	142.6	100.2	108.0	32.2
Tension perpendicular to grain :											
Radial (kg/cm²)	29.3	42.6	13.6	7.9	27.1	50.4	33.9	45.4	68.3	57.6	15.7
Tangential (kg/cm²)	36.4	55.2	19.4	7.6	20.8	62.5	43.5	61.5	79.4	66.4	19.5
Nail Holding Power :											
Side (kg)	165	245	100	28.6	17.3	196	110	—	127	—	–33.3
End (kg)	119	147	60	20.9	17.6	147	47	—	91	—	–60.5
Screw Holding Power :											
Side (kg)	371	550	202	70.6	19	442	401	—	331	—	8.1
End (kg)	229	372	110	55.6	24.2	280	88	—	236	—	–61.6

Table 2

Safe working stresses of Sterculia urens

Working stress	Location		
	Inside	Outside	Wet
Extreme Fibre stress in beams (kg/cm^2)	178 (168)	148 (140)	119 (112)
Shear along grain (kg/cm^2)	14.8 (14.9)	14.8 (14.9)	14.8 (14.9)
Horizontal shear in beams (kg/cm^2)	10.4 (10.4)	10.4 (10.4)	10.4) (10.4
Max. compressive stress parallel to grain (kg/cm^2)	105 (104)	94 (92)	77 (75)
Compressive stress perpendicular to grain (kg/cm^2)	45 (49)	35 (38)	28 (31)
Modulus of Elasticity (1000 kg/cm^2)	145.0 (109.7)	145.0 (109.7)	145.0 (109.7)

Note : Figures in brackets show corresponding values of Standard teak (*Tectona grandis*).

Table 3

Suitability indices of Sterculia urens in terms of teak as 100

Properties	Suitability indices
Strength as a beam	113
Stiffness as a beam	132
Suitability as a post	120
Shock resisting ability	121*
Retention of shape	60
Shear	109
Refractoriness (Splitting coefficient)	50
Hardness	136
Nail holding power	104
Screw holding power	93
Weight or heaviness	134

* Calculated by using strength—sp. gravity relationship (Sekhar & Rawat, 1959).

shape and very hard. Its splitting coefficient is however only 50% of that of teak. It may be mentioned as a general observation that specimens of this wood tended to split frequently on nailing.

Comparing the suitability indices of *S. urens* (sp. gr. 0.759) against those of some other woods in the sp. gr. range 0.746-0.771 (see Table 4), it is interesting to note that this species is superior to all the others in stiffness but quite inferior in refractoriness to splitting and nail/screw holding power to woods of comparable density.

Some uses of this wood have already got established through long usage. The data of this paper supports its suitability for constructional purposes like posts, beams and rafters. It may also be worth trying for medium and heavy duty tool handles.

Table 4

Suitability indices of Sterculia urens comparison to other woods of similar density (*Sekhar & Gulati*, *1972*)

Timber species	Sp. gravity (Oven dry wt) / (Vol. green)	Wt. at 12% m.c.	Strength as a beam	Stiffness as a beam	Suitability as a post or strut	Shock resisting ability	Retention of shape	Shear	Surface hardness	Refractoriness	Nail/Screw holding power
Sterculia urens	0.759	134	113	132	120	121	60	109	136	50	104/93
Aegle marmelos	0.754	132	80	82	82	85	65	140	168	70	127
Anogeissus latifolia	0.757	132	98	93	80	152	71	115	138	75	128
Dalbergia latifolia	0.754	130	95	93	88	115	87	118	155	72	127
Syzygium spp.	0.758	140	96	113	102	98	54	106	136	77	128
Shorea robusta	0.753	130	114	114	111	132	66	133	150	92	127
Termindlia tomentosa	0.746	133	87	96	90	98	65	106	152	72	126
Vitex altissima	0.771	138	114	125	118	90	72	130	177	97	130

Though its retention of shape does not appear to be favourable, in limited mechanised trials the timber has been found to plane and turn to a smooth finish. Although its nail and screw holding power is adequate, it has a low splitting coefficient. Considering the above, it is likely to be suitable after proper seasoning for door and window frames for which it is already reported to be in use in Karnataka. It may also be worth trying after proper seasoning and adoption of alternative jointing techniques (such as use of dowels) for ordinary furniture and joinery. Its low splitting coefficient is however likely to limit extensive use for packing cases and crates.

Its seasoning behaviour needs to be investigated in detail to promote its more extensive utilisation for furniture and joinery.

Acknowledgment

The authors thank Shri R.P. Bashkar and Shri T. Chandra Sekhar for the valuable assistance rendered in this work.

SUMMARY

Comprehensive tests done on physical and mechanical properties of *Sterculia urens* for the first time, have indicated it to be heavy to very heavy, very strong and very hard, but rather poor in splitting coefficient and retention of shape. On the basis of these tests the timber is considered suitable for use as posts, beams, rafters and tool handles. The timber planes and turns to a smooth finish and is also likely to be suitable after proper seasoning and adoption of alternative jointing techniques (such as use of dowels) for door and window frames. ordinary furniture and joinery.

स्टेरकूलिया युरेंस की भौतिक और संधारी विशेषताओं का अध्ययन

पी० कुमार, ए०के० अनंतनारायण व एस०एन० शर्मा

सारांश

स्टेरकूलिया यूरेंस पर पहली बार इसकी भौतिक और संधारी विशेषताओं पर किये गये विस्तृत परीक्षणों से पता चलता है कि यह लकड़ी भारी से बहुत भारी, बहुत मजबूत और बहुत कठोर परन्तु फटन गुणांक और आकृति यथावत् बनाये रखने में कुछ घटिया है। इन परीक्षणों के आधार पर यह प्रकाष्ठ छोटे खम्बों, कड़ियों, शहतीरों, औजारों के हत्थों के लिये उपयुक्त रहेगी। इस पर रंदा और खराद अच्छे चलते हैं और इसकी तल चिकनी बन जाती है और उपयुक्त संशोषण करने और जोड़ बैठाने की वैकल्पिक प्रविधियां अपनाने पर (जैसे डॉवल उपयोग करना) यह दरवाजों और खिड़कियों के चौखटों, सामान्य उपस्कर और बढ़ईगिरी कार्यों के लिये भी उपयुक्त रह सकता है।

References

Anon (1969). Indian Standard Specification for methods of testing small clear specimens of timber. *I.S.* : 1708, *ISI*, New Delhi. (India).

Anon (1974). Indian Standard Specification for method of sampling of model trees and logs for timber testing and their conversion. *I S.* : 2455, *ISI*, New Delhi (India)

Chowdhury, K.A. and S S. Ghosh (1958). *Indian Woods. I.*, Manager of Publications, New Delhi.

Nazma, P.M. Ganapathy, N. Sashidharan, K.M. Bhat and R. Gnanaharan (1981). *A Hand-Book of Kerala Timbers, KFRI Report No. 9*, Division of Wood Science, Kerala Forest Research Institute, Peechi-680653, Kerala.

Pearson, R.S. and H.P. Brown (1932). *Commercial Timbers of India.-I.* Govt. of India, Central Publications Branch, Calcutta.

Sekhar, A.C. and B.S. Rawat (1959). Studies on effect of specific gravity on strength considerations of Indian timbers. *Journ. of Inst. of Engr.* (*India*) **39** **(8)**, *Pt. I.*

....(1966). Physical and mechanical properties of teak from different localities in India and neighbouring areas. *Ind. For. Rec.* (*N.S.*) **1** **(13).**

Sekhar, A.C. and A.S. Gulati (1972). Suitability indices of Indian timbers for industrial and engineering uses. *Ind. For. Rec.* (N.S.) T.M. **2** (1).

Sekhar, A.C. and S.S. Rajput (1972). Safe working stresses of Indian timbers. *Ind. For. Rec.* (N.S.) T.M. **2** (2).

RESEARCH NOTES

(I)

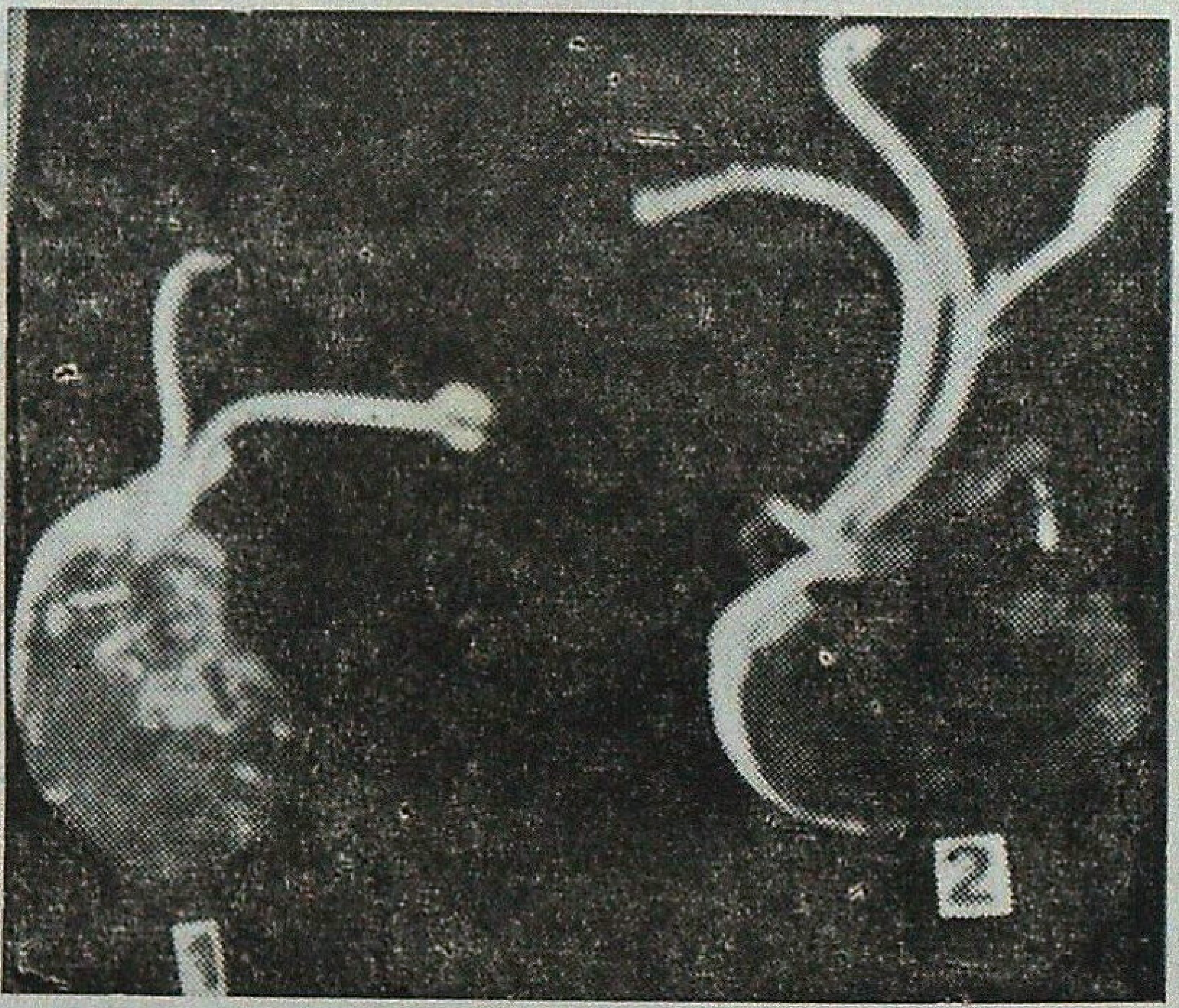
TWIN AND TRICOTYLEDONOUS SEEDLING OF *BUTEA MONOSPERMA* (LAM.) TAUB.

During the course of study of seed germination in *Butea monosperma* some abnormal seedlings were recorded.

The pods of *B. monosperma* were collected from R.F.R.C. Campus in April 1987 and were stored at room temperature (20–30°C). The petriplates for germination studies were incubated in BOD incubator at 30 ± 2°C by following the technique recommended by ISTA (1976).

One per cent tricotyledonous seedling and two per cent twin seedlings were observed out of 100 seedlings screened after one week of germination. These abnormal seedlings contain two plumules and three plumules (Fig. 1). Such abnormal seedlings could not survive after transfer in polypots as compared with the normal seedlings. The origin of these abnormal seedlings may be due to polyembryony or genetic variability. Adarsh Kumar *et al.* (1977), Dabral (1977) and Kulkarni & Srimathi (1981) also reported such abnormality in forest tree species. There is no such previous record of abnormality in *B. monosperma.*

Figs. 1–2



1. Twin seedling.
2. Tricotyledonons seedling.

References

Adarsh Kumar, H.P. Bhatnagar and C.S. Venkatesh (1977). Twin seedling in Sisham (*D. sissoo* Roxb). *Indian For.*, **103** (11) : 770.

Dabral, S L. (1977). Polyembryony in Teak. *Indian For.*, **103** (10) : 694.

ISTA (1976). International rules for seed testing. *Seed Sci. & Technol.* **4** (1) : 3–177.

Kulkarni, H.D. and R.A. Srimathi (1981). Polyembryony in the genus *Santalum* L. *Indian For.*, **107** (11) : 704 –706.

Regional Forest Research Centre,
Jabalpur (Madhya Pradesh)

Mamta Purohit
and
Jamaluddin

(II)

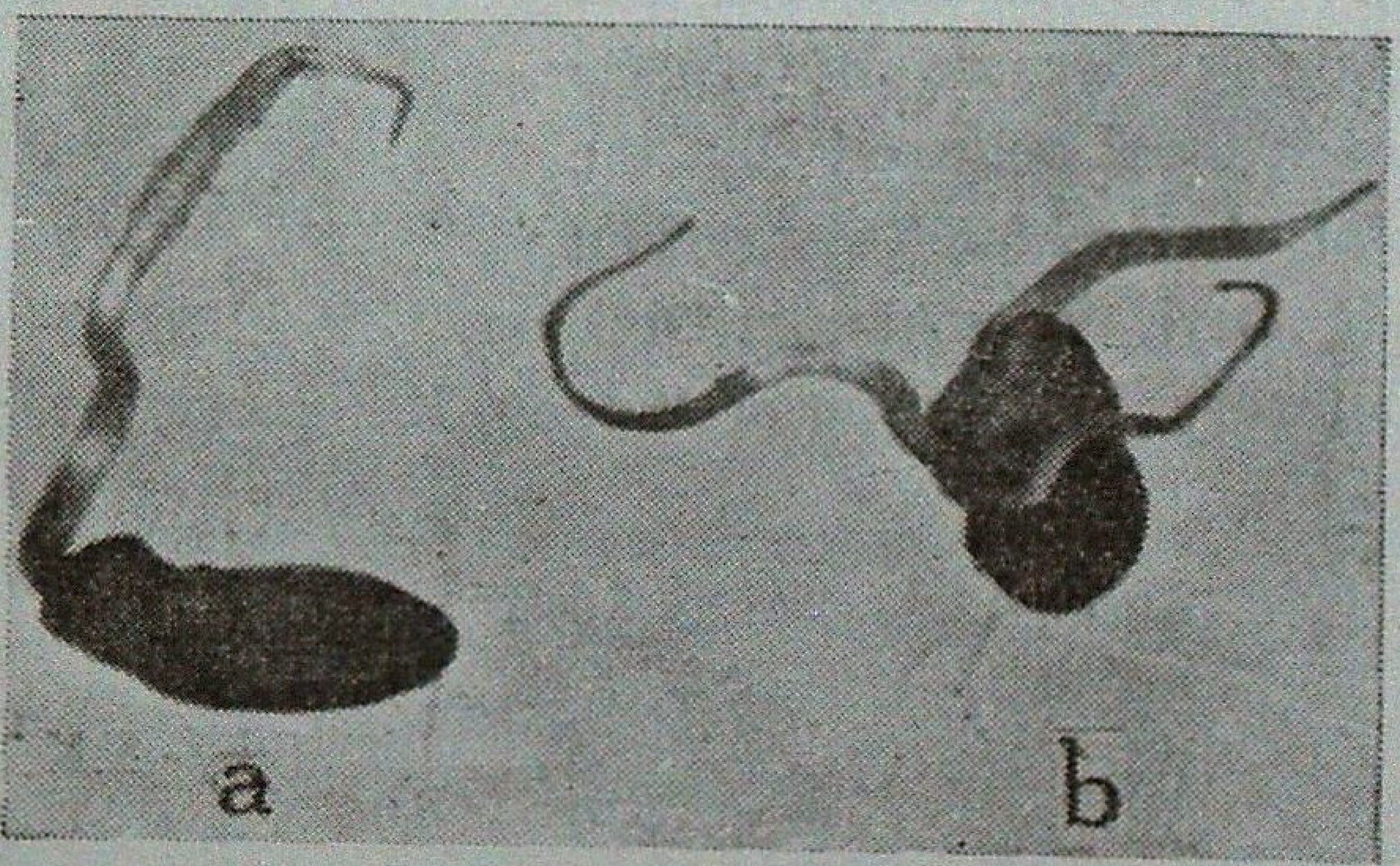
TRIPLET SEEDLINGS IN SHISHAM (*DALBERGIA SISSOO* ROXB.)

Dalbergia sissoo Roxb., popularly known as sissoo or Shisham is one of the most important timber species of India. During a study on the effect of seed-borne fungal culture filtrates on the germinability of sissoo seeds it was observed that out of the 600 seeds sown under different fungal treatments and two controls (Sterilized distilled water and Czepeks solution) one seed among a lot of 50 seeds treated with Czepeks solution produced triplet seedlings (Fig. 1). All the three seedlings of the triplet were almost equal in size and were curved away from each other in three different directions.

When fully emerged, the individual seedlings of this triplet were transferred to germination pots filled with garden soil and kept at room temperature (about 25±2°C) to observe their further development. There was no further growth in any of the seedlings of this triplet and all the seedlings died after one week from the date of their transplanting, where as no casualty was observed in case of all the three normal seedlings used as controls.

Occurrence of twin seedlings have been reported in a number of forest tree species including *D. sissoo*, however there is no record of occurrence of triplet seedlings in *D. sissoo* so far in the published literature. The present report is, therefore, the first ever record of occurrence of triplet seedlings in *D. sissoo*. Incidentally it is also the first record of the occurrence of triplet seedlings in any broad-leaved species.

Fig. 1



Triplet seedlings in *Dalbergia sissoo*.
(a) Normal seedling.
(b) Three seedlings of the triplet curved away from each other.

Disease Insect Survey Branch,
Forest Research Institute,
Dehra Dun (India)

A.K. Vijayan
and
P.S. Rehill

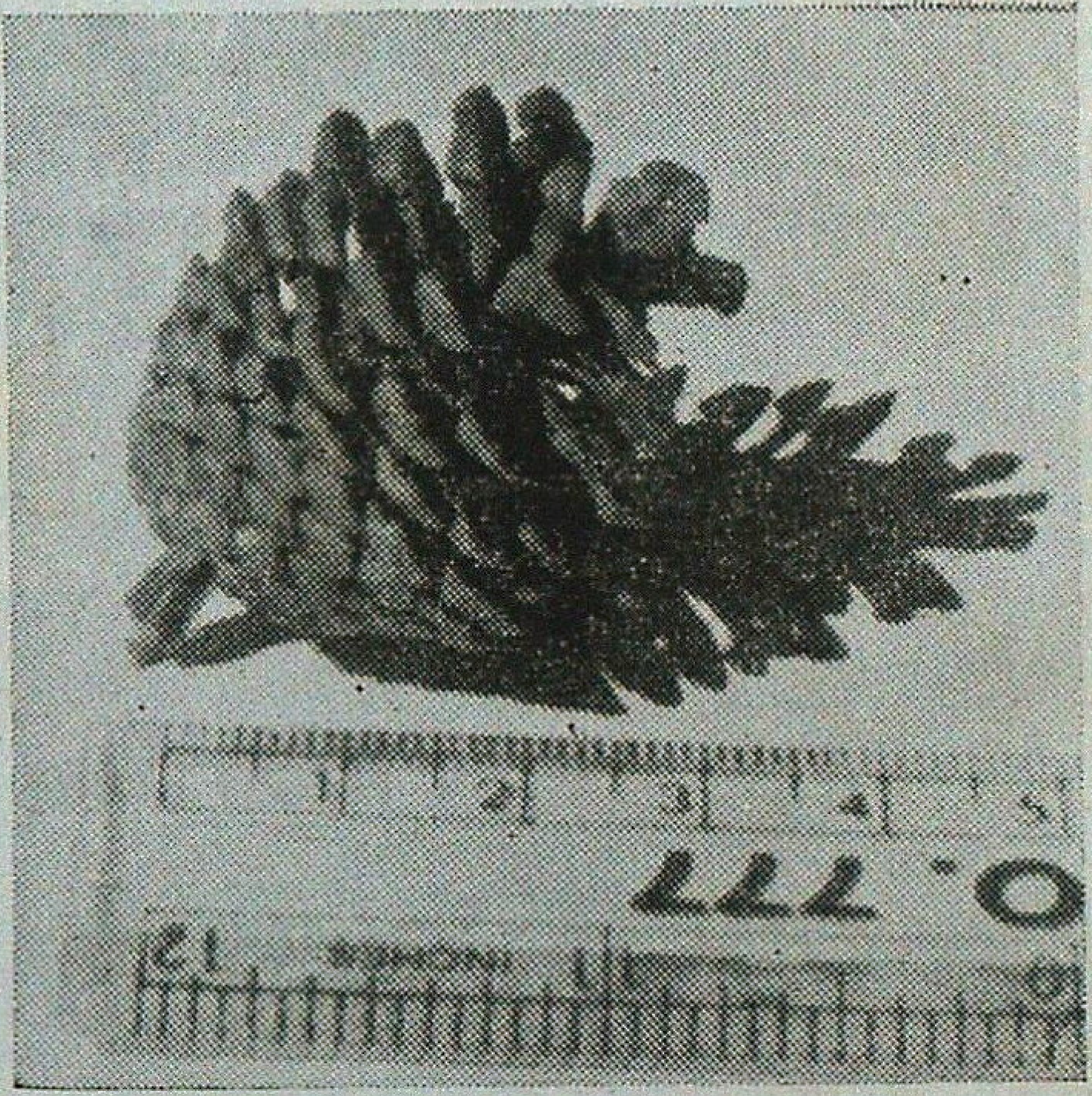
LETTER TO THE EDITOR

To,

The Hony. Editor,
Indian Forester,
P.O. New Forest,
Dehra Dun.

Sub : An interesting Dwarf Cone of chir-pine

Dear Sir,



The photograph is of a dwarf female cone of chir-pine (*Pinus roxburghii* Sarg.). The average size of the cone is between 11.5 to 22 cm long and 6.25 to 8.75 cm in diameter (Troup, 1921). The collected cone specimen is matured, attained the size of 4.05 cm long and 3.25 cm diameter. There were reduction of about 73% in length and 57% in width of female cone when compared with Troup's monumental work on chir-pine cones (1921). This is an abnormal and interesting feature probably because of genetic factors. The specimen was collected by the authors during course of their research visits from the pine forests of Siah Devi, West Almora Division, U.P. hills. The specimen is preserved in Forest Ecology Laboratory, Department of Botany, Kumaun University Campus, Almora.

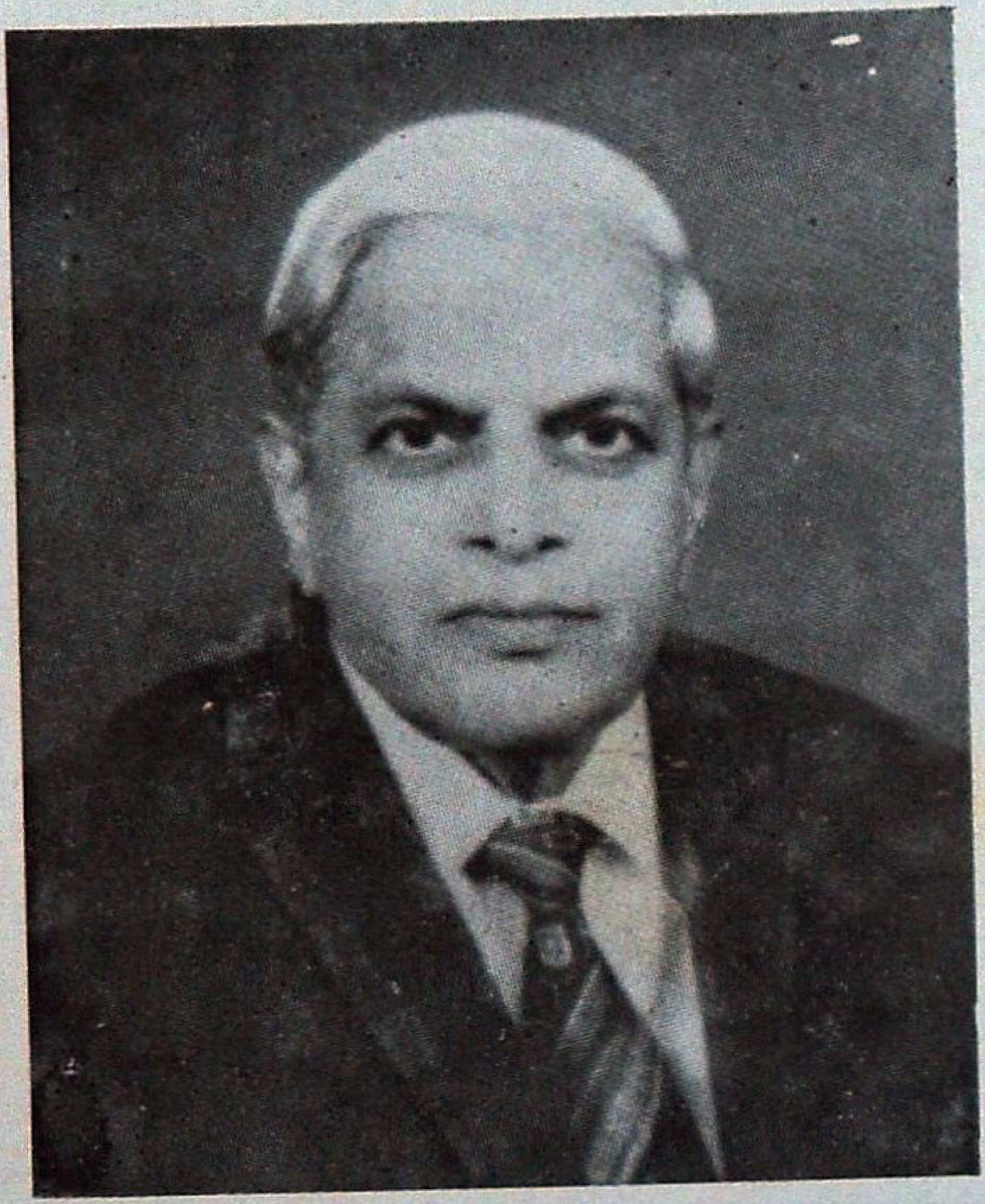
Yours faithfully,

Sd./- S.K. Singh and K.R. Verma
Department of Botany,
Kumaun University Campus,
Almora (U.P.)

OBITUARY

Y.M.L. Sharma

(31.12.1915—4.4.1988)



Prof. Y.M.L. Sharma attained heavenly abode on 4th April 1988 evening after a brief illness. He was 72.

Shri Y.M.L. Sharma hailed from an educated family of Kolar District in the princely state of Mysore. On completion of Masters Degree in Science from the Central College at Bangalore, he was trained in forestry in the Indian Forest College at Dehra Dun in 1943. He came into Indian Forest Service at its initial constitution in 1966. He served with distinction as an able forest administrator and retired as Chief Conservator of Forests, Karnataka State in December 1973. He had the unique distinction of working as Dean of Indian Forest College, Dehra Dun and Principal, Southern Forest Rangers College, Coimbatore for about 14 years because of which he had updated knowledge of forests of the country as well as latest technological developments in the field of forestry all over the world.

After retirement he worked as visiting Professor on Farm Forestry in the University of Agriculture Sciences, Bangalore. He opened the first ever international forestry consultancy in Karnataka at Bangalore which he conducted with a sense of service and dedication to the cause of forestry, wildlife and environment. He was consultant to Food and Agricultural Organisation of U.N.O. at Rome, Asian Development Bank, Bangkok and a number of National and International Organisations. He had toured widely in Europe, Asia and Far East and attended a very large number of National and International Forest Conferences. He was also Food and Agricultural Organisation Consultant for bamboos. He had prepared many environmental projects for Kudremukha Iron Ore Co., National Mineral Development Corporation Ltd., Neyveli Lignite Corporation Ltd.,

Baildela Donmalia Iron Ore Project, Singrauli Collieries, and several Units of Coal India Ltd. He was a Director on the Board of Mysore Paper Mills. He was an active member of several committees constituted by State and Central Governments in the field of forestry, wildlife and environment. He was Vice-President of Gram Vikas an Organisation for Rural Development in Kolar District.

He was scholarly and a prolific writer. He has a large number of scientific articles and publications to his credit.

Mr. Sharma is survived by his daughter, daughter-in-law, grand children and a very large number of mourning disciples.

May his soul rest in peace.

N. S. A.

GAZETTE NOTIFICATIONS

KARNATAKA GAZETTE

On return from training Shri B.J. Hosmath, IFS, is appointed with immediate effect and until further orders as Deputy Conservator of Forests, Karwar Division, Karwar vice Shri G.B. Narvekar, IFS, retired.

Shri Ashok Kumar Singh, IFS, Deputy Conservator of Forests, Tumkur is appointed with immediate effect and until further orders as Deputy Conservator of Forests, Social Forestry under the Zilla Parishad, Kolar vice Shri D.N. Lakshmana Reddy, Deputy Conservator of Forests, transferred.

Shri Shivanna, IFS, Deputy Conservator of Forests, Sagar Division, Sagar, is appointed with immediate effect and until further orders, as Deputy Conservator of Forests, Tumkur Division, Tumkur vice Shri Ashok Kumar Singh, IFS, transferred.

Shri R. Udai Kumar, IFS, Assistant Conservator of Forests, Malur Sub-Divison, Malur, is promoted to officiate in the Senior Scale of Indian Forest Service and appointed with immediate effect and until further orders, as Deputy Conservator of Forests, Bangalore Divison, Bangalore vice Shri M. Jayaram, IFS, transferred.

Shri G. Vidya Sagar, IFS, Assistant Conservator of Forests, Doddaballapur Sub-Division, Doddaballapur, is promoted to officiate in the Senior Scale of Indian Forest Service and appointed with immediate effect and until further orders as Deputy Conservator of Forests, Social Forestry under the Zilla Parishad, Belgaum vice Shri V.R. Kulkarni, transferred.

Shri V. Rangaswamy, IFS, Assistant Conservator of Forests, Mundugod Sub-Division Mundugod, is promoted to officiate in the Senior Scale of Indian Forest Service and appointed with immediate effect and until further orders, as Deputy Conservator of Forests, Sagar Division, Sagar, vice Shri Shivanna, IFS, transferred.

Shri V.R. Rulkarni, Deputy Conservator of Forests, Social Forestry, under the Zilla Parishad, Belgaum, is appointed with immediate effect and until further orders as Deputy Conservator of Forests, Varahi Forest Division, Thirthahalli, vice Shri C.T. Kashi, retired.

The services of Shri D.N. Lakshmana Reddy, Deputy Conservator of Forests, Social Forestry, under the Zilla Parishad, Kolar are placed at the disposal of the Karnataka State Forest Industries Corporation Limited, Bangalore for appointment as Deputy Conservator of Forests against the newly created post with immediate effect and until further orders.

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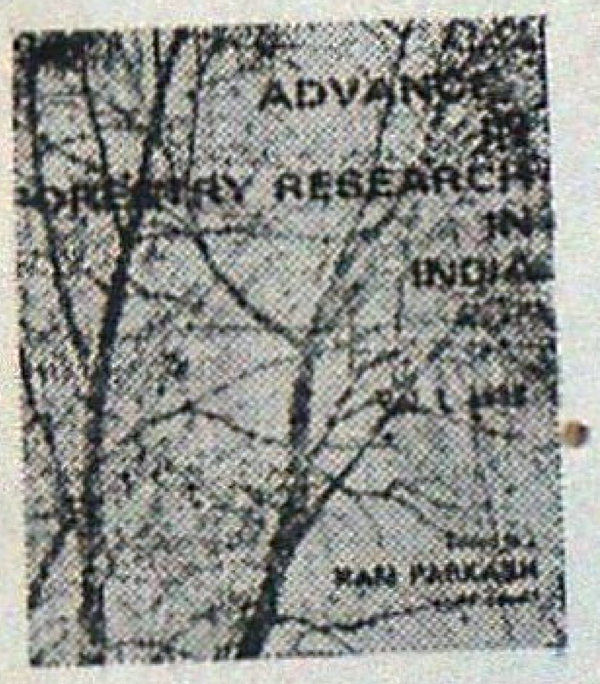

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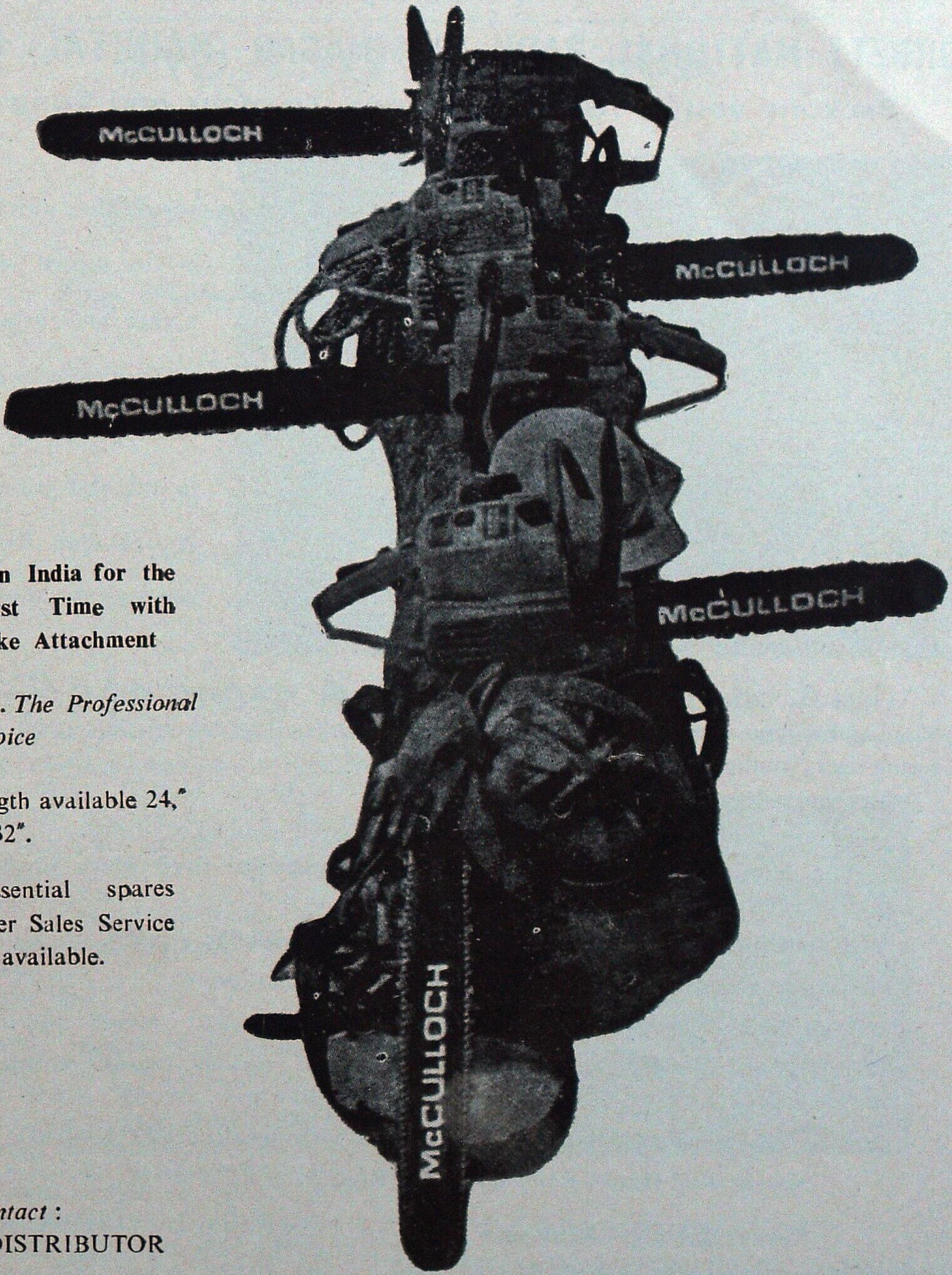

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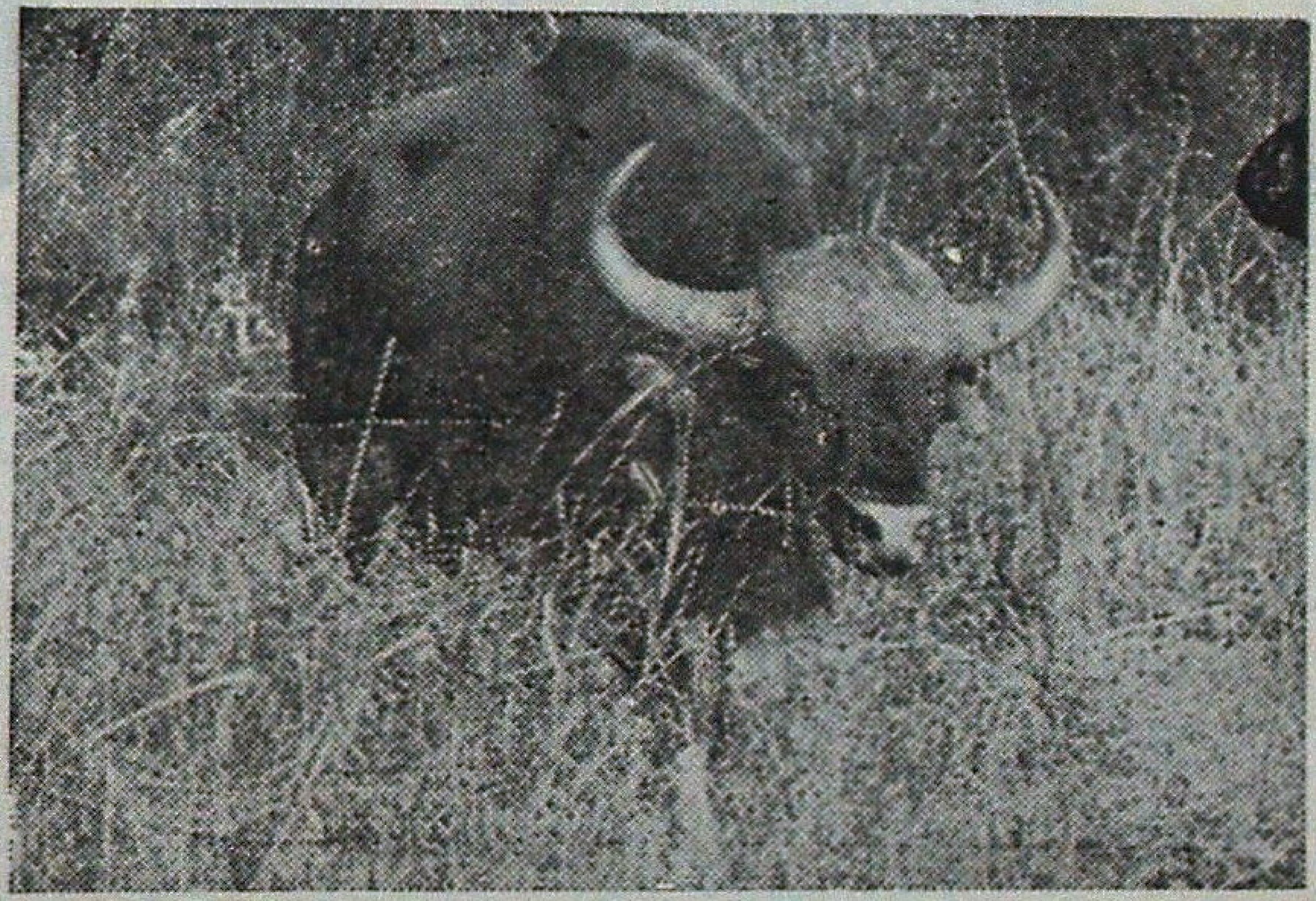

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(A Govt. of Arunachal Pradesh Undertaking)

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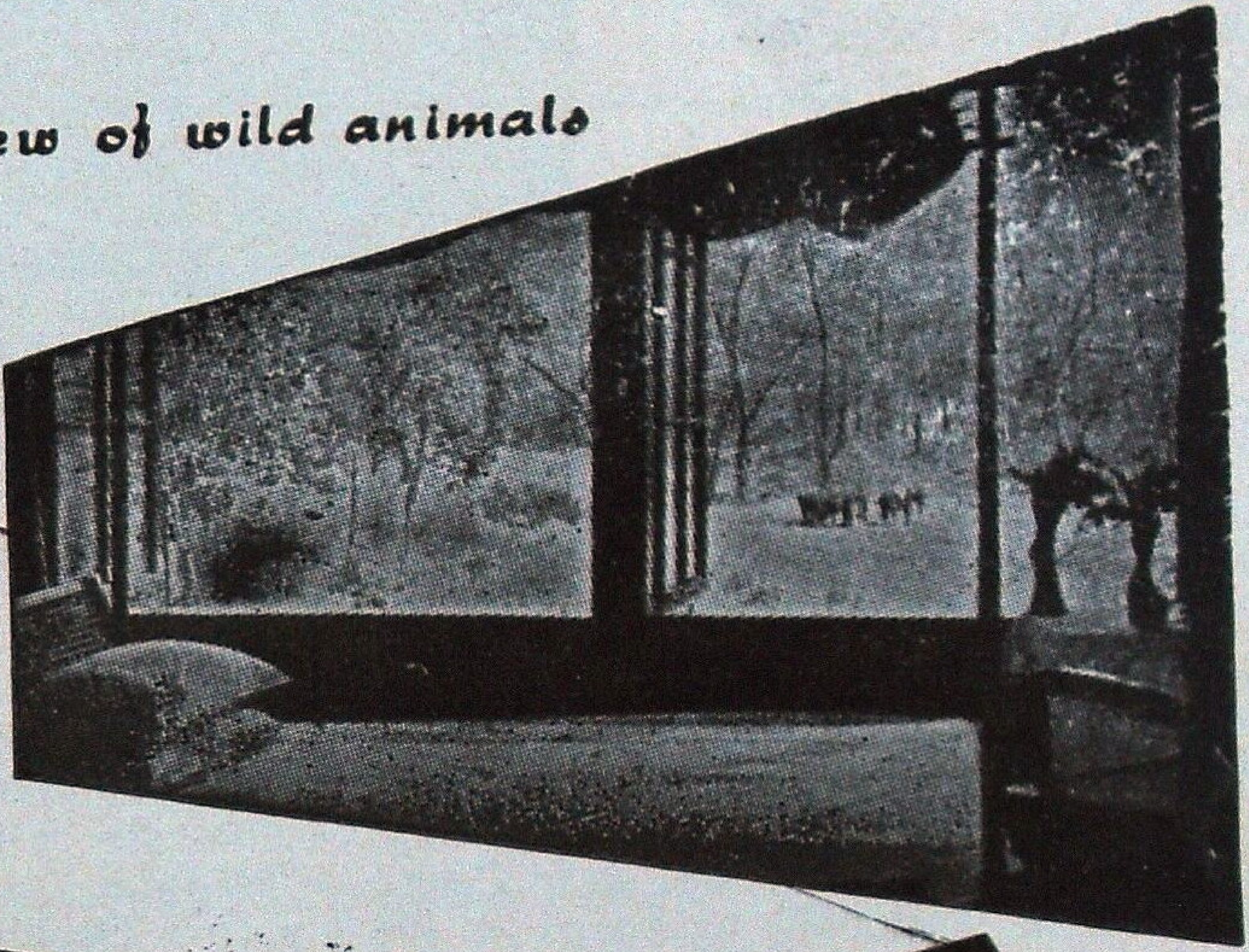

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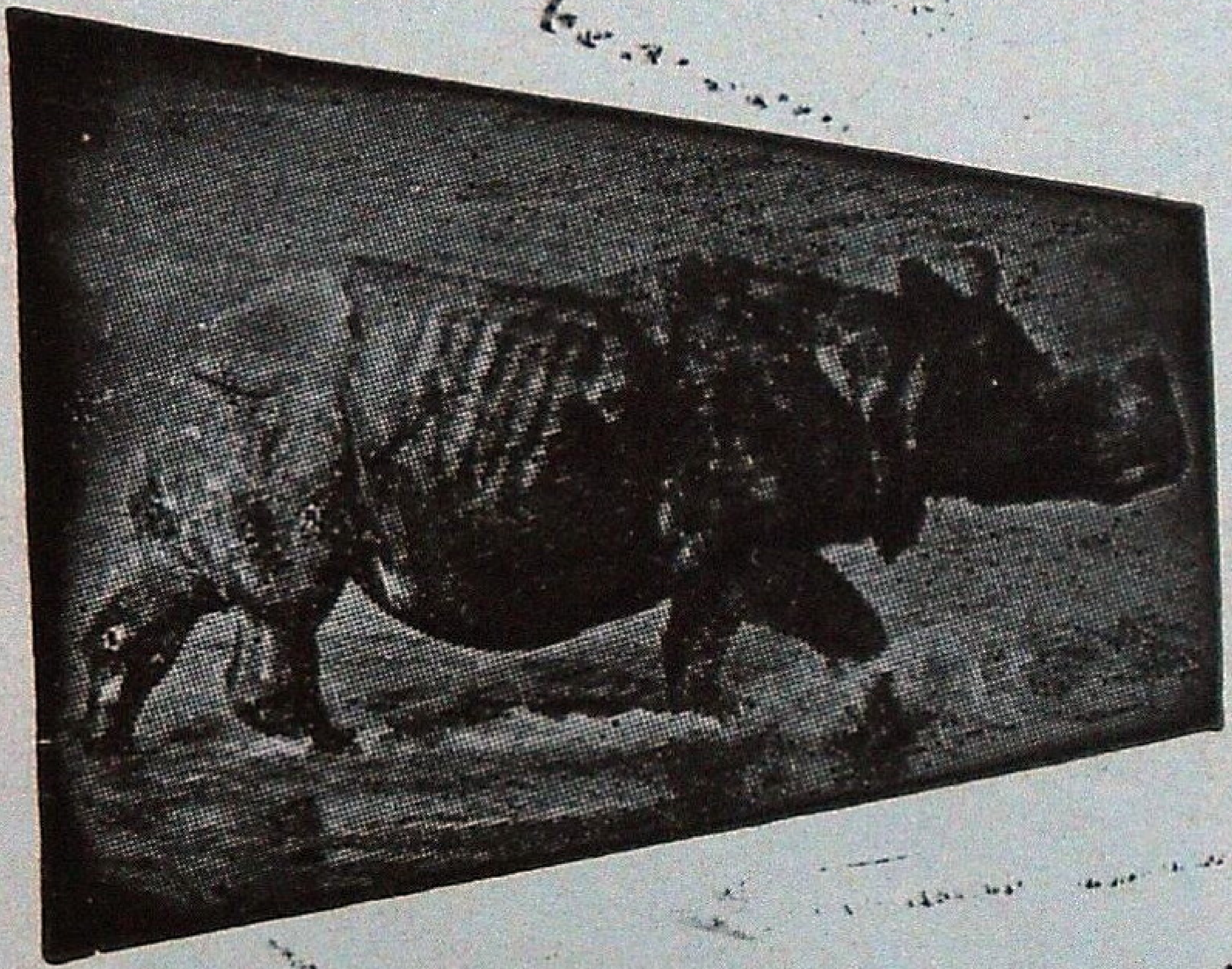

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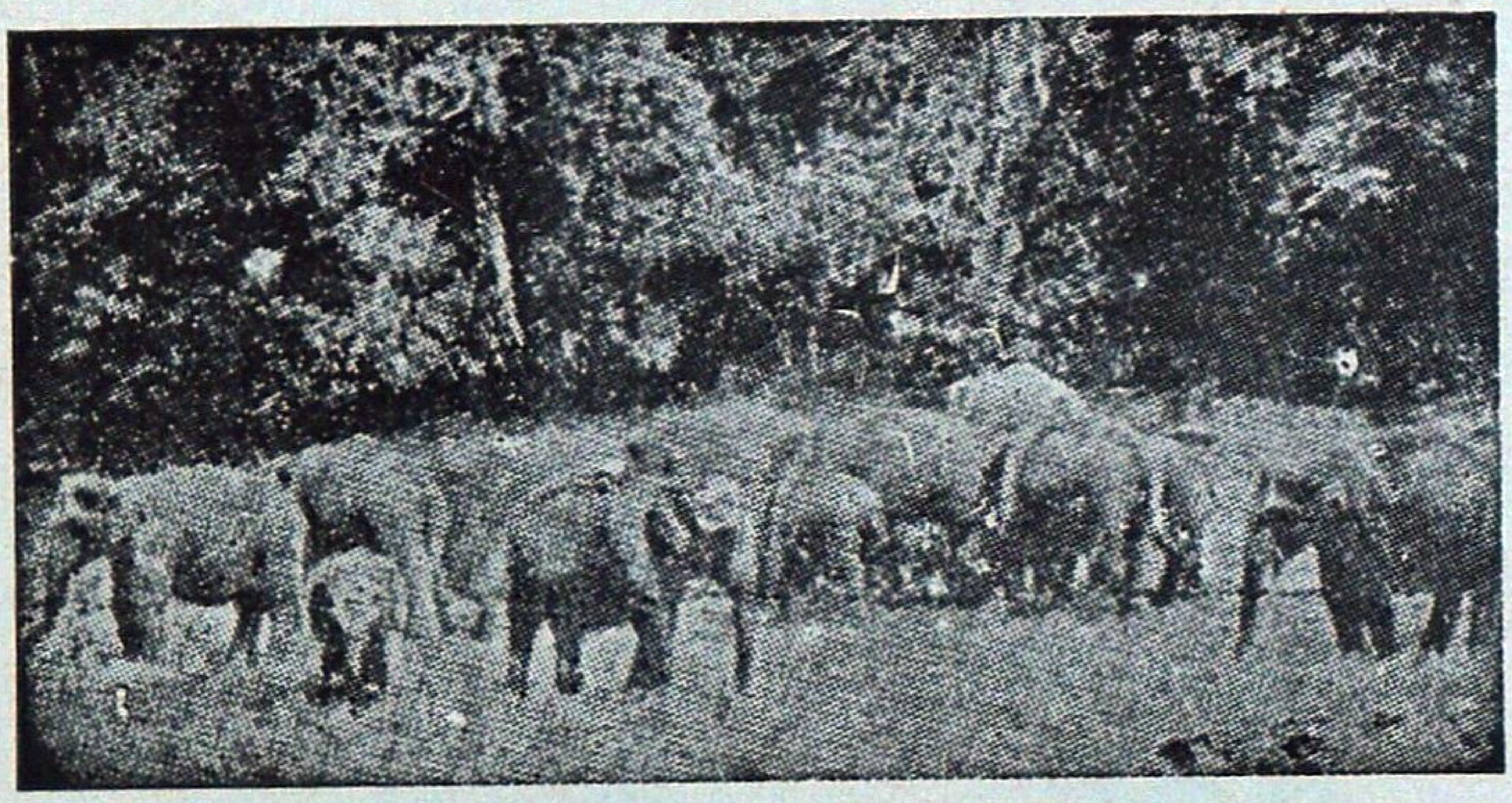

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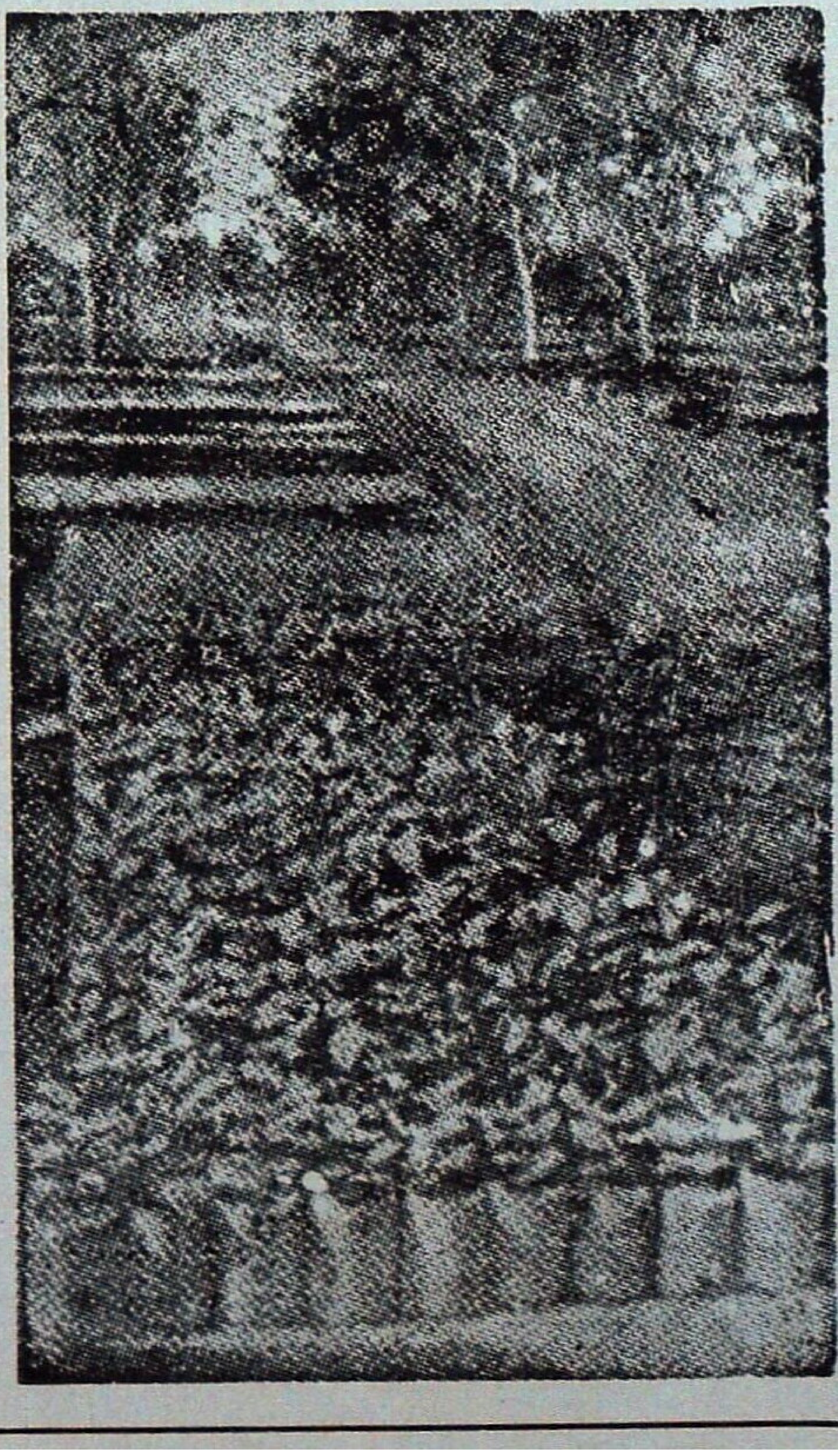

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(A Govt. of Himachal Pradesh Undertaking)

SHIMLA

HPFSC marches ahead towards a better tomorrow under the dynamic guidance and leadership of Hon'ble Chief Minister Shri Vir Bhadra Singh.

Himachal Pradesh State Forest Corporation has taken long strides under the benevolent guidance of our Chairman Prof. Chander Kumar, Hon'ble Minister of State for Forests.

* With complete nationalisation of forest working viz; timber operations, resin tapping etc. both in Govt. and private forests, there is complete elimination of contractor' agency. Modernisation of timber operations has reduced conversion wastage considerably and the incidence of organized illicit felling in forests is completely under control.

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c) Providing incentives to officers and staff through prompt action on service matters like confirmations, job rotation vis-to-vis career planning including specialized training.

(V.P. Mohan)
Managing Director.

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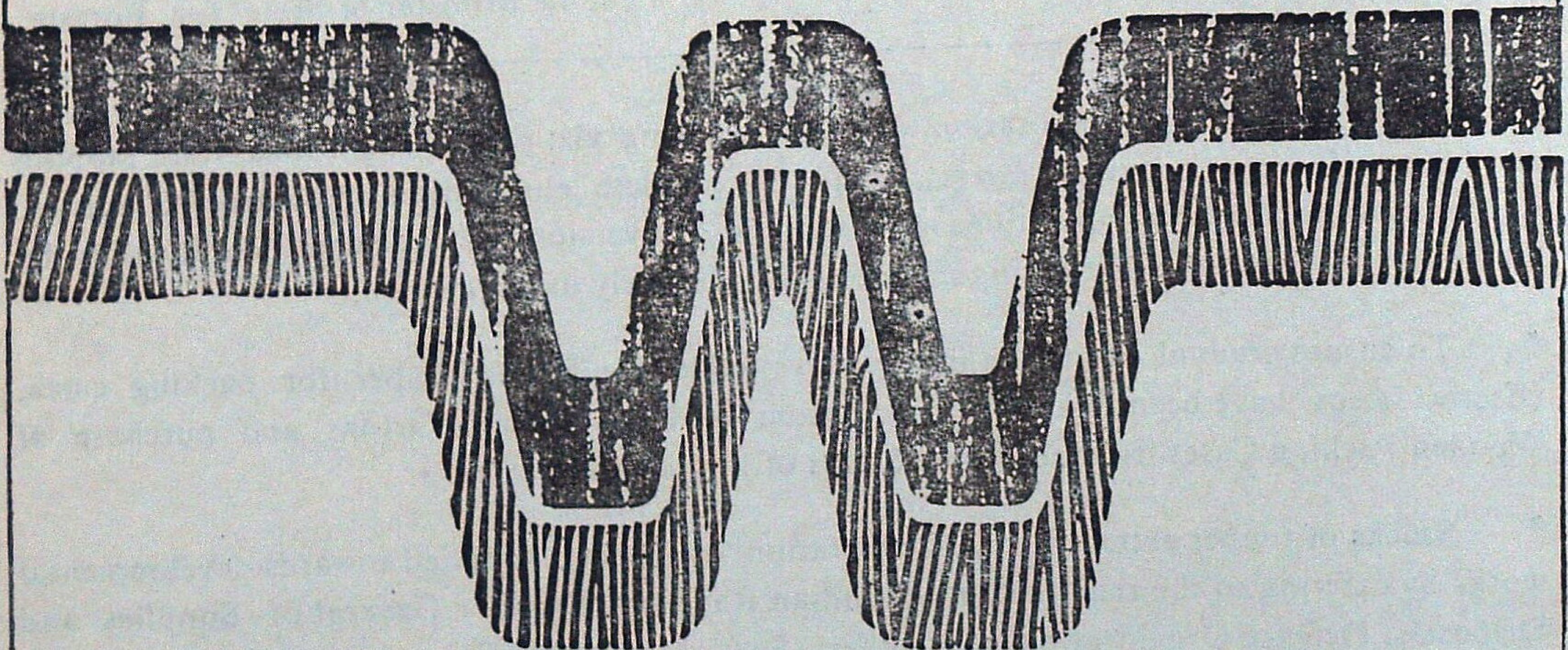

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Managing Director.

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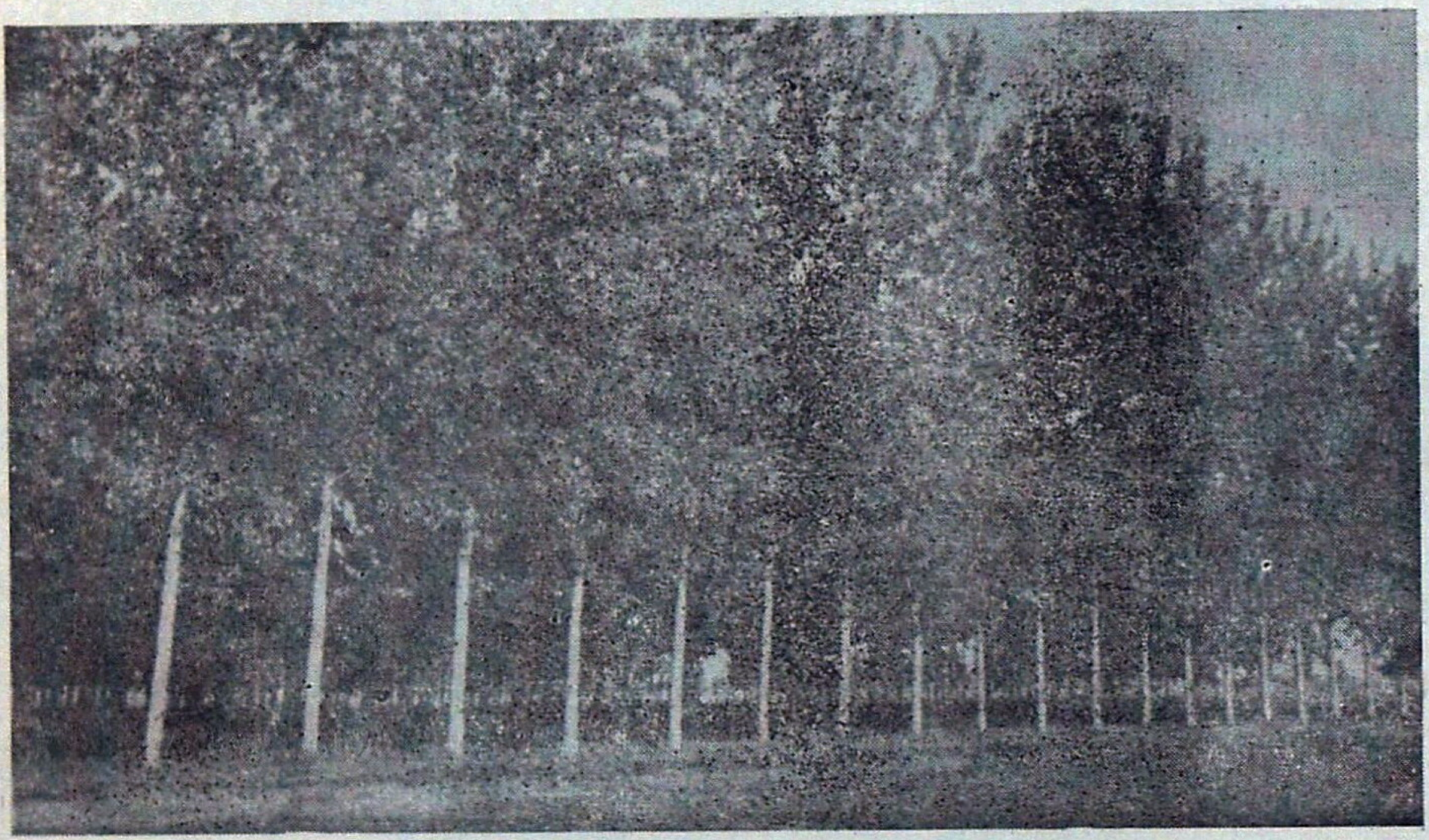

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Meerut : F-194, Shastri Nagar. Ph: 73202
Chandigarh : 224, Sector 18-A. Ph: 20558
Karnal : 843, Sector 13, Urban Development Estate.

Mizoram Forests Through The Years

During the British period i.e. from 1890 till the year 1952, the management of Inner Line Reserved Forests was done under the supervision of Superintendent of District. The District was put under 'Excluded Area' and practically no Statutory Act or Law were enforced to manage the Forests. Practically nothing had been done. The Inner Line Reserved Forests was constituted under the Assam Forest Regulation comprising an area of 559 sq kms.

When the Mizo District Council came into being in 1952, the management of all the Forest other than the State Inner Line Reserved Forests was handled by the District Council. Thence the District Council started to make its own Forest Wing. Under the District Council one Forest Division called Aizawl Forest Division was created comprising the then whole area with headquarters at Aizawl In fact during the time of the then District Council, most accessible areas of the forests had been overtapped for earning more revenue and due to population pressures.

In the early 1960's the first plantations were raised by the District Council in different centres. During the year 1966 - 1968, practically no plantation could be raised due to political disturbance in the Mizo District.

After Mizoram became a Union Territory in the year 1972, the Union Territory Government formed one more Forest Division with headquarters at Lunglei.

The present position of Mizoram Forest Department may be summed up as follows :

The Mizoram Forest Department is headed by the Chief Conservator of Forests. The field work has been taken up with ten (10) Territorial Divisions. In addition to this, six (6) Functional Divisions have been set up. There are now three (3) Circles namely—Southern Circle, Northern Circle and Research & Development Circle. The Government of Mizoram has already constituted three Wildlife Sanctuaries in order to preserve its vanishing Wildlife. Four more Wildlife Sanctuaries are being proposed which are likely to be constituted very soon. The Mizoram Forest Department has created 1,00,029 hectares of plantation upto 1987 as against 967 hactares before it attained U.T. Status.

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Supplying treated sleepers to the Railways and treated wooden poles to the Electricity Board from their Wood Preservation Plants at Shimoga and Mangalore.

Supplying high quality handlooms for the weaving industry fabricated at Shimoga and Dandeli saw mills.

Fabricating and supplying furniture to Government Departments, Corporations, Societies and Institutions. Furniture orders are also accepted.

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Recently, the Corporation has established the use of eucalyptus on commercial scale in fabrication of packing cases and manufacturing door and window frames.

For further details, please contact the Managing Director, Punjab State Forest Development Corporation Limited, Chandigarh.

Y.P CHOWDHRY
MANAGING DIRECTOR

Madhya Pradesh Forges Ahead ; Forestry for the People

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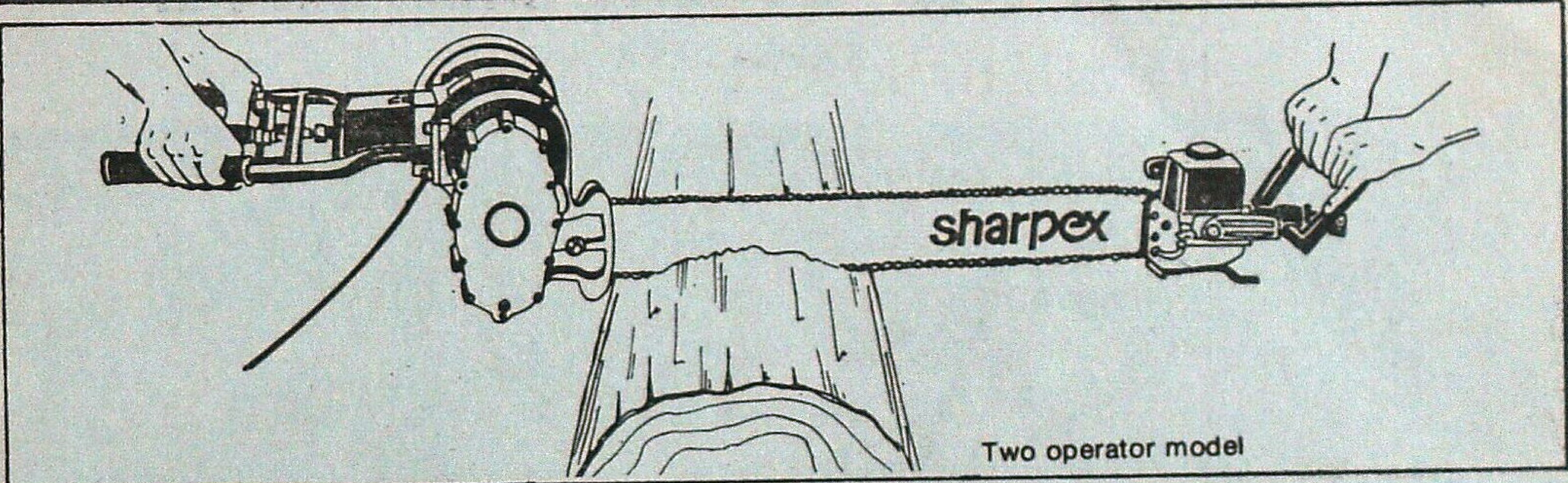
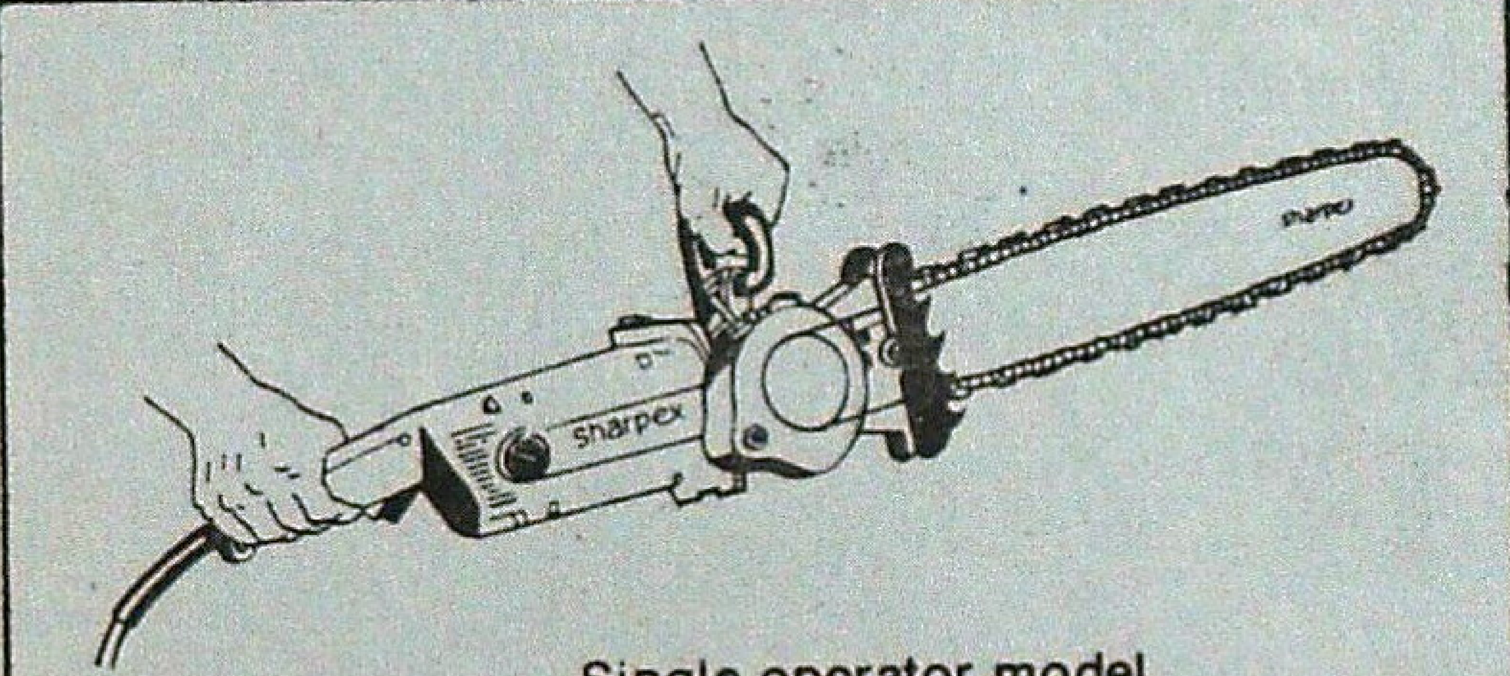
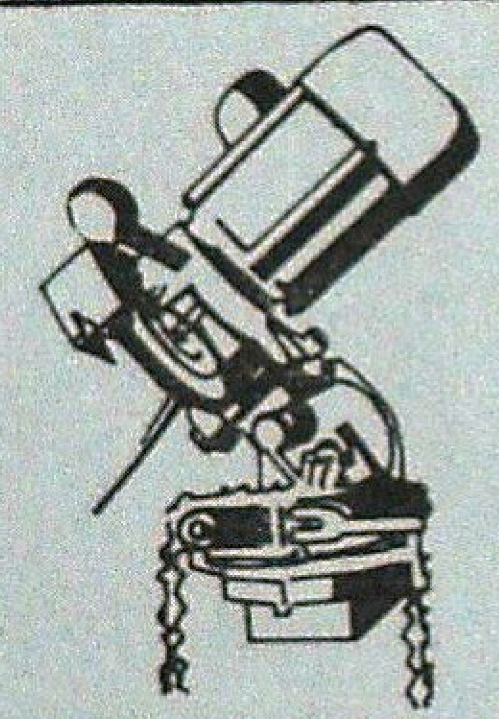


Two operator model



Single operator model



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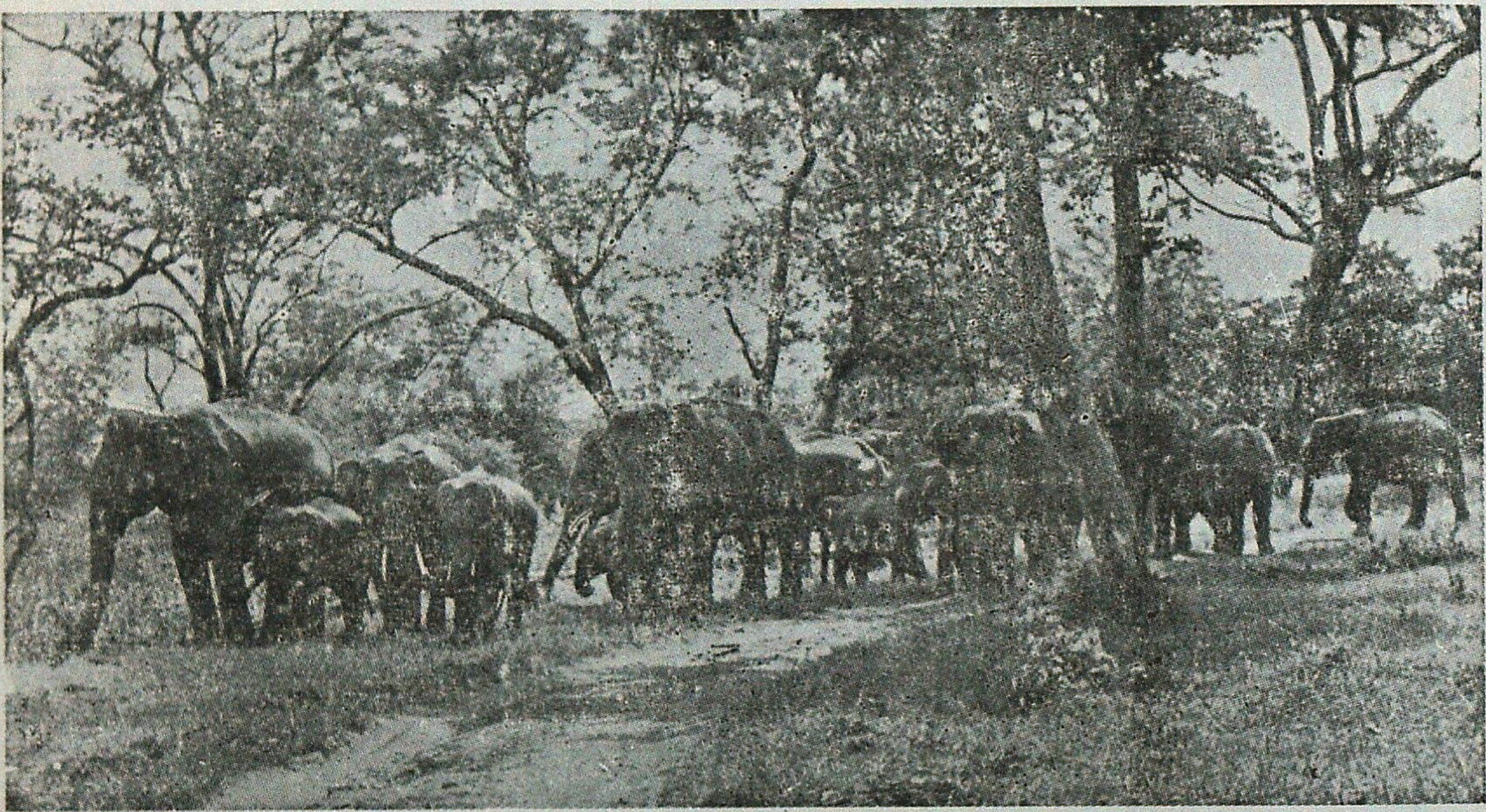
BANDIPUR TIGER RESERVE

KARNATAKA



Lovers of nature and Wildlife the world over find it well worth their while to linger on in Bandipur. More famous as a Tiger Reserve, Bandipur enjoys reputation as a wildlife sanctuary that stretches as far back as 1931. The Mysore Maharajas; benign rulers and farsighted visionaries understood the compelling necessity of protecting the fauna, avifauna and flora from the thoughtless foreys of marauders. Today 874 sq kms. of the Bandipur National Park makes up the Tiger Reserve which is one of India's finest parks.

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Nature at its bountiful best—Bandipur bestows the soothing solace of jungle retreat off the beaten track and far from the madding crowd.

For further particulars, please contact

The Field Director
'Project Tiger'
Government House Complex
MYSORE—570 010
(Karnataka—State)—India
Telephone No. 20901

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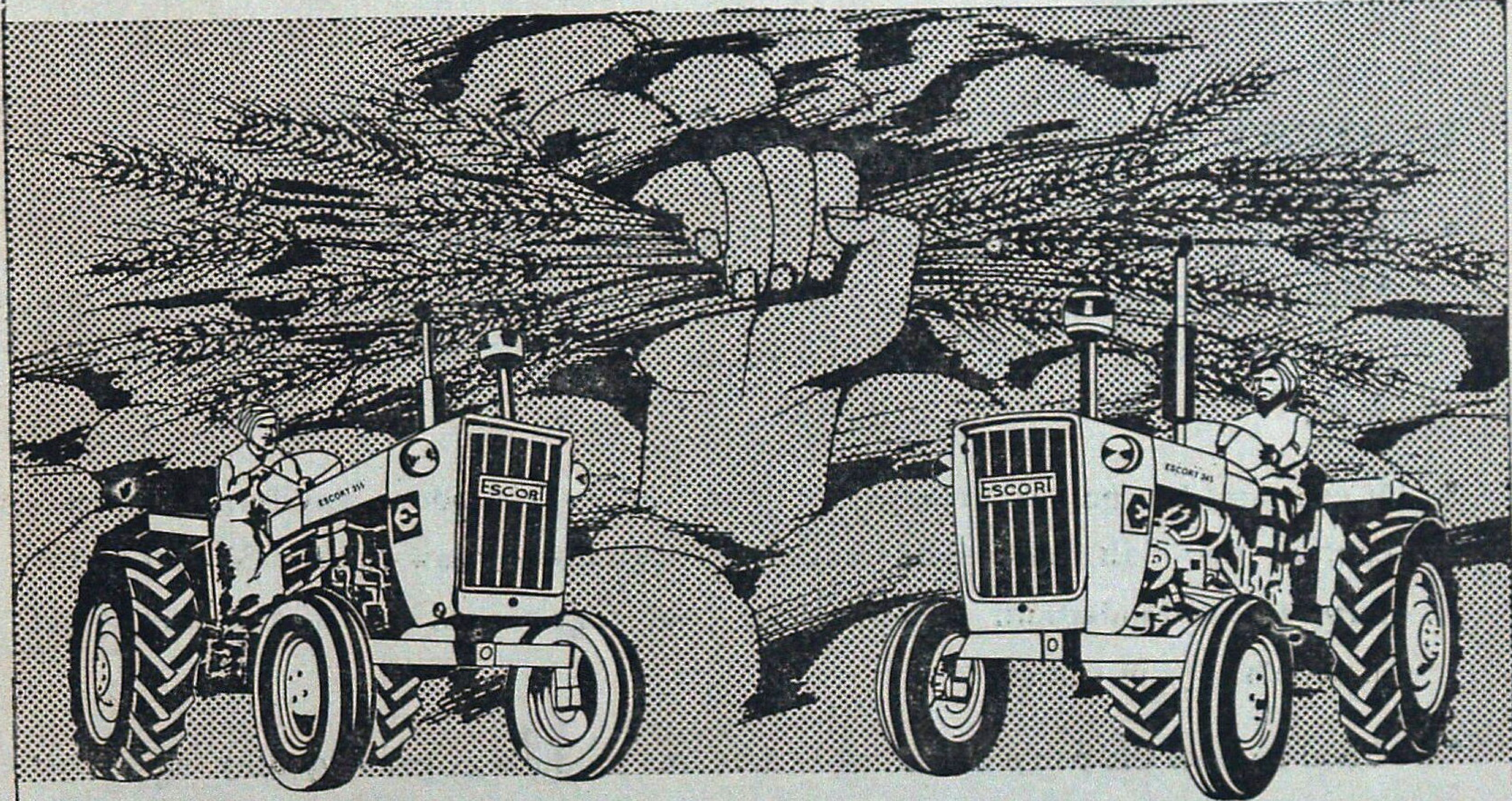

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West Bengal Forest Development Corporation Limited

(A Government of West Bengal Undertaking)

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